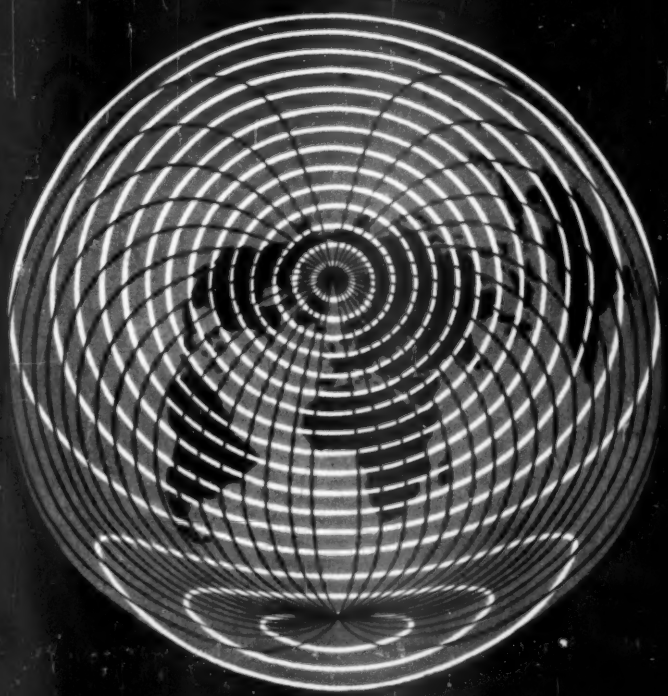
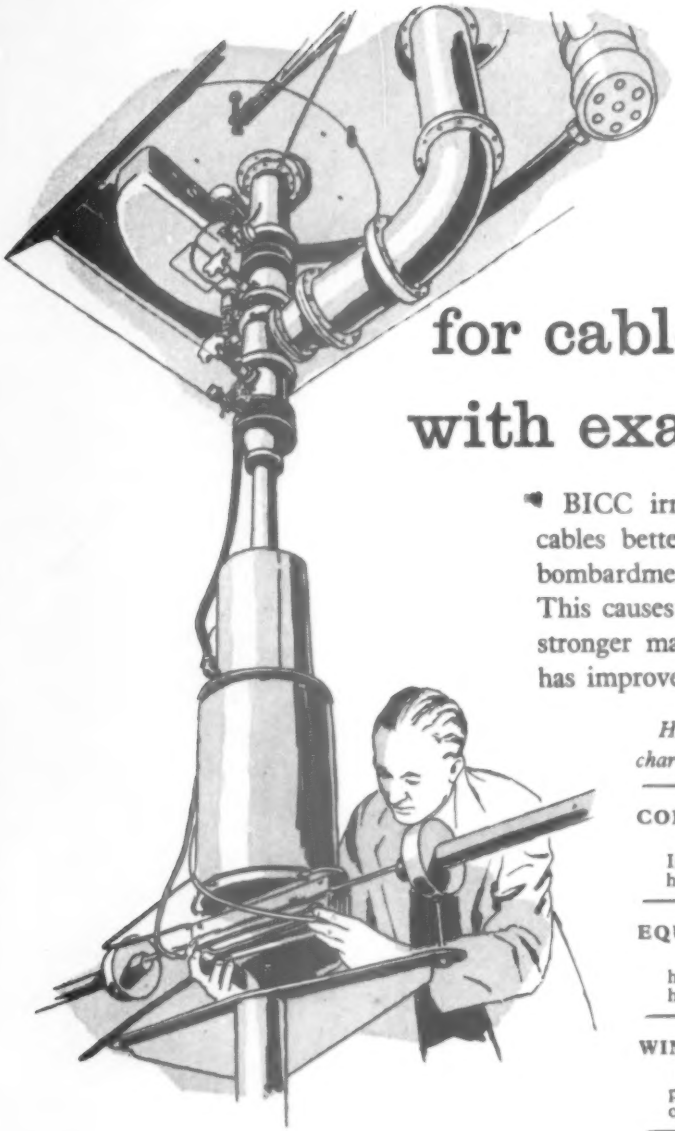
Wireless World

ELECTRONICS





Adjusting the scanning unit of the electron accelerator.

for cables and wires with exacting duties

BICC irradiate polythene to make good cables better. The process is basically the bombardment of polythene with electrons. This causes a chemical change, resulting in a stronger material, which is more elastic and has improved temperature characteristics.

Here are some BICC products with improved characteristics resulting from irradiation:—

CONTROL CABLES

Multi-core cables, insulated and sheathed with Irradiated Polythene, have improved short-term high temperature characteristics.

EQUIPMENT WIRES

Irradiated Polythene insulated equipment wires have improved soldering properties and enhanced high temperature performance.

WINDING WIRES

Irradiated Polythene insulation gives better performance for wires subject to intermittent overload conditions.

COAXIAL R/F CABLES

Irradiated Polythene core permits higher temperature soldering of radio frequency cable terminations.

Full details of these BICC products are available on request.

BICC *IRRADIATED POLYTHENE* **cables & wires**

BRITISH INSULATED CALLENDER'S CABLES LIMITED, 21 BLOOMSBURY STREET, LONDON, W.C.1

FERGUSON choose the Model 8 AvoMeter for their Television & Electronic Laboratory

Photograph by courtesy of Thorn Electrical Industries Ltd.

A.C. VOLTAGE: 25 mV. to 2,500 volts.
A.C. CURRENT: 1 mA. to 10 amps.
D.C. VOLTAGE: 25 mV. to 2,500 volts.
D.C. CURRENT: 0.5 microamps to 10 amps.
SENSITIVITY:
20,000 ohms per volt on all D.C. ranges.
1,000 ohms per volt on A.C. ranges from 100 volts upwards.
RESISTANCE:
0 to 20 megohms (using internal batteries).
0 to 200 megohms (using external D.C. supply).
DECIBELS: —15dB to +15dB.

Various accessories are available for extending the above ranges.

FERGUSON are typical of the many leading manufacturers of electronic, radio and television equipment who rely on AVO instruments.
The Model 8 AvoMeter shown in use is a 30-range self-contained A.C./D.C. moving coil instrument, produced primarily for the electronic, radio and television engineer. The upper photograph shows a mounted pivot under examination. This is only one of many operations carried out in a special air-conditioned dust-free zone in the AVO factory to ensure the highest possible standards of accuracy and reliability.

Size: 8¼ x 7¼ x 4¼ inches.
Weight: 6¼ lbs. (approx.) including leads.

List Price: £23 : 10s.

AVO LTD

Telephone: VICtoria 3404 (9 lines)

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To Sales Department,
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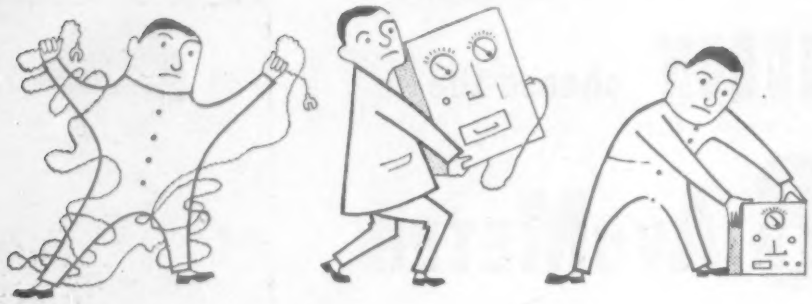
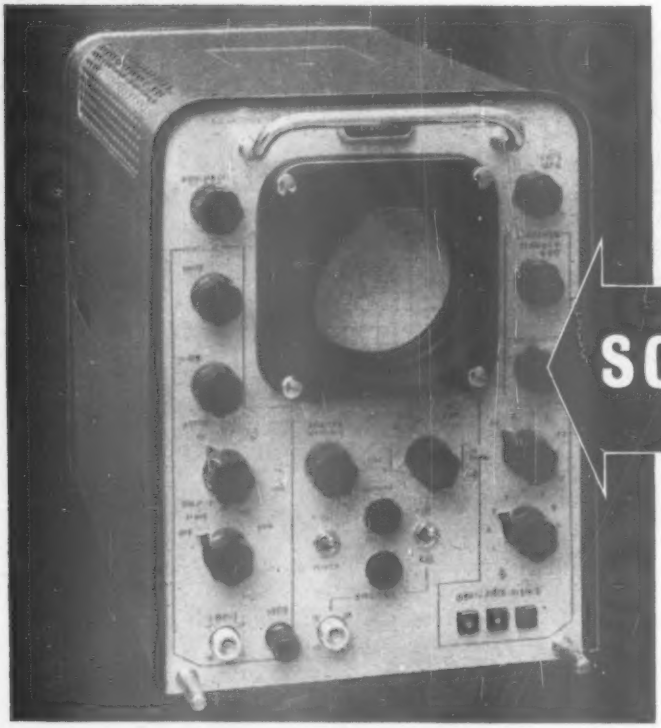
92-96 Vauxhall Bridge Road,
London, S.W.1.

Please send fully illustrated Brochure describing the Model 8 AvoMeter. W.W

A



Three men went to mend . . .



But now one man and his

SOLARSCOPE
CD814

do the job in half the time

For radio or TV servicing where the gain/bandwidth product is of vital importance, the new CD814 Solarscope scores every time. One man and his 814 are all that is necessary for response tracing, display and accurate measurement of TV frame or line signals, examination of time-base waveforms and similar tasks. Why not multiply the effectiveness of your staff—today? The cost is only £115!.....a fraction of the salary of another engineer.

BANDWIDTH :	0.9 c/s—9 Mc/s (3 db) — 12 Mc/s (6 db)
MAX 'Y' SENSITIVITY :	Better than 40 mV/cm
RISE TIME :	Better than 40 mμSec
TIME MARKERS :	At 0.1, 1.0, 10 and 100 μSec intervals
TIME-BASE RANGE :	0.02 μSec/cm to 0.01 Sec/cm
DIMENSIONS :	14½" × 10½" × 20" (37 × 27 × 49 cm.)
WEIGHT :	42 lbs. (19 kg.)

THE SOLARTRON ELECTRONIC GROUP LTD

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In quantity production
and available now for
industrial applications

NEW High Gain Audio Transistor OC75

gives you more
than you had before

The new general purpose audio transistor OC75 gives you more gain than earlier types and its large scale production gives you the assurance of immediate availability. It is a high current gain development of the widely used OC71 and its α' range is from 60 minimum to 130 maximum at 3mA collector current.

Transistors OC70 and OC71 will, of course, remain fully available for those instances where the characteristics of a lower current gain stage are required. The present family of three types, the OC70, OC71 and OC75, each with a comparatively narrow range of α' spread, therefore covers all designers' requirements for low level audio amplifiers, low power low speed switching, low power non-linear applications, industrial control and interlock circuits and the many applications in which general purpose audio transistors are used.

Write to the address below for full data on the OC75 and other Mullard transistors.

Abridged Data

Typical current gain with grounded emitter (α') ...	90
Maximum voltage, d.c. (V)	−20
Maximum voltage, peak (V)	−30
Maximum collector dissipation at 45°C (mW) ...	75
Maximum junction temperature (*continuous operation*)	75°C
Maximum junction temperature	90°C
(*intermittent operation—total duration 200 hours max.*)	

MULLARD LIMITED
Semiconductor Division
Mullard House · Torrington Place
London W.C.1 · LANgham 6633

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M152a

Two NEW Measuring Oscilloscopes . . . .

STORAGE OSCILLOSCOPE type S01

On show for the first time, this instrument uses the new English Electric E702 storage tube which allows a transient to be displayed for ten minutes or more. Full use is made of the improved tube characteristics in the design of the associated amplifiers and time-base. Precise time and voltage calibration facilities are provided.

ADVANCE INFORMATION

Developed from the oscilloscopes supplied for ZETA this unit incorporates many advanced features. A 20th Century two-gun tube is used with a continuously variable E.H.T. supply. Direct coupling is used on both deflection amplifiers and on the scan generator circuit. Comprehensive triggering facilities ensure reliable operation. All power supplies are stabilised.

TWO CHANNEL OSCILLOSCOPE type TC1

. . . . at the Physical Society's Exhibition

For full details visit stand 16 or contact :

CAWKELL RESEARCH & ELECTRONICS LTD

SCOTTS ROAD
SOUTHALL · MIDDLESEX

Telephone : SOUthall 3702/5881

MUTUAL & SELF INDUCTANCE BRIDGE

Designed for the accurate measurement of either mutual or self inductance and resistance in the range 0·001μH to 30mH and 100μΩ to 3000Ω respectively.

All measurements are made in the form of a four-terminal network and inductance and resistance of leads and clips are not included in the measurement.

Accuracy within ± 1% frequency 1592c/s (ω = 10 000)

Full technical information on this and other 'Cintel' Bridges is available on request.

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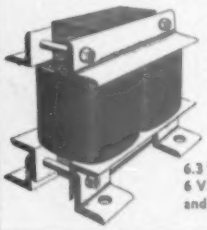
Atkins, Robertson & Whiteford Ltd., Industrial Estate, Thornliebank, Glasgow
McKellen Automation Ltd., 122 Seymour Grove, Old Trafford, Manchester 16

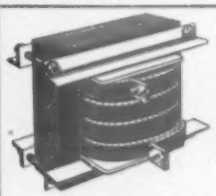
TRANSFORMERS

All for 220/250 V. Input, Other Supply Voltages as Required
CONTINUOUS RATING. Short Rating Transformers also available

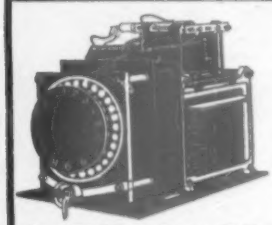
Each of the eight Transformers below:—



£5.19.6.
OUTPUTS:
12 V. 40 Amps.
6-12-18-24-30 V. 12 Amps.
5 V. 80 Amps
18 V 30 Amps.
110-120 V. 4 Amps.
55 V. 12 Amps.
6.3 V. 18 Amps or 12.6 V. 9 Amps.
6 V. 5 Amps. and 53 V. 15 Amps.
and 30 V. 1 Amp.

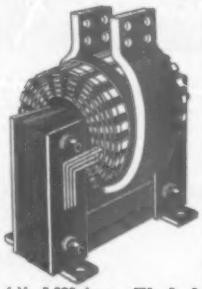


5 v. 140 Amps.	£8 10 0
110-120 V. 10 Amps.	£11 0 0
40 V. 25 Amps.	£10 0 0
5 V. 300 Amps.	£12 10 0
13-14-15 V. 60 Amps.	£11 15 0
6-12 V. 50 Amps.	£8 10 0
17 V. 40 Amps.	£8 15 0
110 V. Centre Tapped 55 V. 25 Amps.	£26 0 0
10-15-25 V. 100 Amps	£26 0 0
6-8-10-18-24 V. 100 Amps	£28 0 0

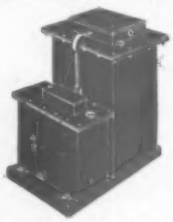


VOLTAGE REGULATING TRANSFORMERS
£28.0.0

Input 230/240 V. Output 50 V. to 250 V. in 16 steps of 12.5 V. at 30 Amps. These are Auto Transformers with Quick Make-and-Break Tapping Switches.



4 V., 5,000 Amps.	£70 0 0
2 V., 10,000 Amps.	£68 0 0
3.5V.,20,000Amps.	£110 0 0
2 V., 30,000 Amps.	£130 0 0
10 V., 2,000 Amps.	£69 0 0



CONSTANT VOLTAGE TRANSFORMERS

Input 188 V. to 265 V.
For stabilising the supply Voltage of Electronic equipment, etc. Output 230 V. ± 12 V., at 3 Amps. Giving stability of better than 1½% for each supply Voltage. £45.

10 V. 1,000 Amps.	£46
10 V. 500 Amps.	£33
10 V. 750 Amps.	£39
9 V. 900 Amps.	£36
12 V. 1,000 Amps.	£50
15 V. 1,000 Amps.	£56
20 V. 800 Amps.	£60
10 V. 300 Amps.	£23

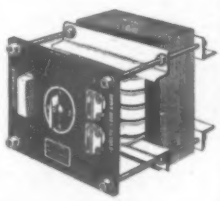
PORTABLE SHROUDED TRANSFORMERS
Each of the five Transformers below:—
£7.18.0.

6-8-12-18-24-30 V., 12 Amps.
24 V., 30 Amps
110-120 V., 4 Amps.
12 V., 40 Amps.
55 V., 12 Amps.

Most Transformers up to 2 kVA can be supplied in a steel case with protected terminals and carrying handle

TRANSFORMERS WITH SWITCHED TAP CONTROL

Available with one or more Switches, Ammeters, Fuses etc.



MANY OTHER STOCK TRANSFORMERS

RECTIFIER SETS

All for 200/250 V. A.C.
(Other supply Voltages available)

Rectifier Sets with D.C. Output Control by internal taps
D.C. Volts ON LOAD are stated.

110/120 V. D.C., 10 Amps.	£29 0 0
200/250 V. D.C., 10 Amps	£36 0 0
200/250 V. D.C., 18 Amps.	£46 0 0
35/38 V. D.C., 50 Amps.	£40 0 0
34 V. D.C., 10 Amps.	£22 0 0
1,200 V. D.C., 200 mA.	£18 0 0
60 V. D.C., 5 Amps.	£22 0 0
200/250 V. D.C., 9.5. Amps.	£32 0 0
6.3 V. D.C. 13 Amps. and 220 V. D.C. 110 mA.	£18 10 0

Rectifier Sets with Control of D.C. Output by Internal Taps. Fitted with Fuses D.C. Volts ON LOAD are stated.

12/25 V. D.C., 12 Amps	£15 10 0
12/25 V. D.C., 20 Amps.	£21 0 0
12/15 V. D.C., 15 Amps	£13 10 0
90/115 V. D.C. 25 Amps.	£40 0 0
15 V. D.C., 5 Amps., Meter and Internal Rheo	£8 10 0
6.3 V D.C., 13 Amps. and 220 V., 110 mA.	£18 10 0
Fitted Ammeters and Voltmeters, per meter	£2 10 0
Built-in Rheostats	£3 0 0

LOW VOLTAGE SAFETY TOOLS & TRANSFORMERS

12 V. HAND DRILL, ¼in. cap. ... £6 10 6
24 V. HAND DRILL, ¼in. cap.... £8 18 6

These drills are for use on a fully charged Battery or on an A.C. source of a higher voltage.

SAFETY TRANSFORMERS TO RUN THESE TOOLS

200/250 V. input, 20 V. A.C. output, for 12 V. drill	£7 18 0
200/250 V. input, 37 V. A.C. output, for 24 V. drill	£7 18 0

SAFETY TRANSFORMERS for all low Voltage hand lamps, tools and other appliances, are available for standard and non-standard outputs.

RECTIFIER SETS
350/440 V. 3 Phase Input

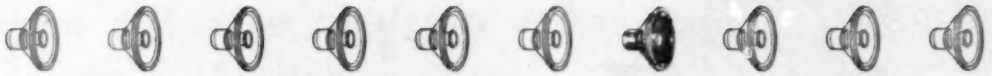
12 V. 400 Amps. or 24 V. 200 Amps intermittent	£60
35/38 V. D.C., 50 Amps.	£40

SPECIFIC ENQUIRIES

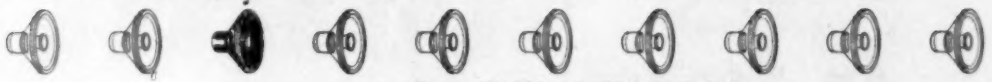
are invited for Transformers and Rectifiers

We specialise in
HEAVY CURRENT EQUIPMENT

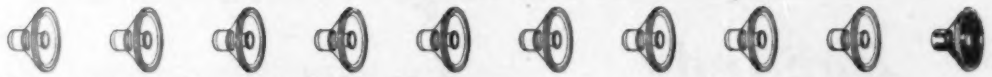
HARMSWORTH, TOWNLEY & CO. 2, JORDAN STREET, MANCHESTER 15 *Central 4281*



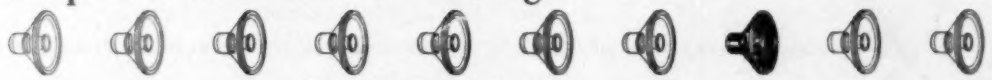
of every hundred



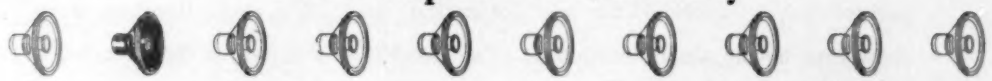
VITAVOX DU 120



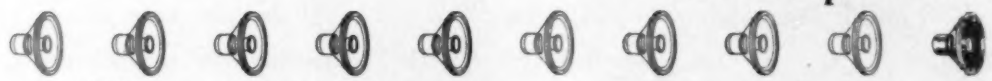
Duplex Coaxial Full Range



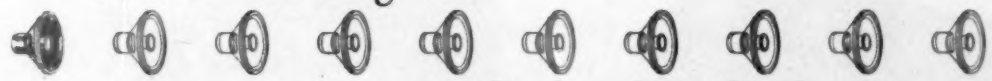
Loudspeakers, ninety



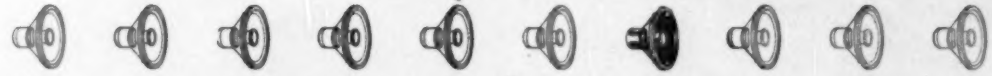
are exported.



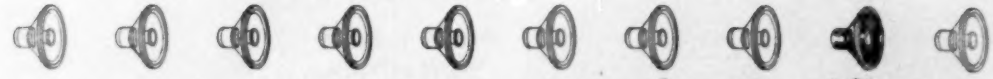
The remaining ten



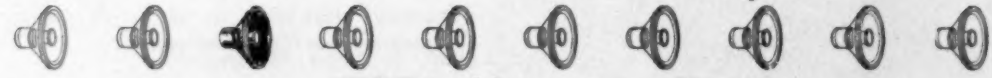
may be hard to find



but the result



more than justifies



the effort involved

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VITAVOX

DU120 DUPLEX COAXIAL

Full Range

Loudspeakers

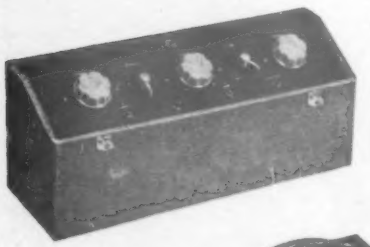
£19·10s.

Stereo Tapes or Stereo Records

ENJOY BOTH THIS FERROGRAPH WAY

The Ferrograph Series 3S is an extremely versatile instrument. Although to all intents and purposes a normal Tape Recorder, recording and playing back monaurally, it is fitted with an additional "in line" (or stacked) head. As a result, therefore, *at any future time*, by the simple attachment of an external unit known as the Stere-Ad, it will play stereo tapes. Alternatively, when used in conjunction with any inexpensive record player fitted with a 45/45 stereo pick-up, it will also play stereo records.

Essentially the Stere-Ad incorporates two matched pre-amplifiers (one for each track), together with a second 2½ watts power amplifier. Connecting the Stere-Ad to the 3S enables the two pre-amplifiers and the two power amplifiers (one already in the Ferrograph and the other in the Stere-Ad) to provide a 2 x 2½ watts matched output for feeding into any suitable external speaker system.



Available in two Models:

3 S/N 3¾/7½ i.p.s. . . . 89 gns.

3 S/H 7½/15 i.p.s. . . . 96 gns.

Stere-Ad Unit (when required) . . . **30 gns.**

All Models include 7" Reel of Ferrotape

The Incomparable

Ferrograph

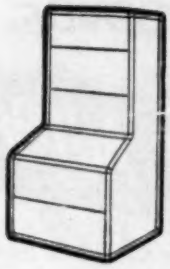
BRITISH FERROGRAPH RECORDER CO. LTD · 131 Sloane Street · London S.W1 · Tel: SLOane 2214/5 & 1510

A subsidiary of The Ferrograph Company Ltd.

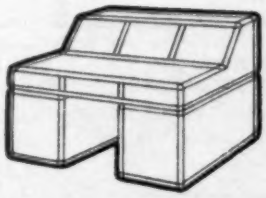
make them in no time with

imlok

and cut out tool costs!



This unique, low-cost construction system comprises aluminium alloy extrusions and locking corner connectors. It's simplicity itself: precision cases, cabinets and other structures can all be quickly built to your own design without incurring tool costs. Smart . . . speedy . . . strong . . . you'll find Imlok a boon for research and prototype work and so often the answer to a production problem too. Write now for full information.



Here's the secret of IMLOK'S strength

The extrusions slide over the long arms of the connector - overlapping and gripping it to give positive lock

IMLOK ***cheapest in the short run . . . cheaper in the long run***

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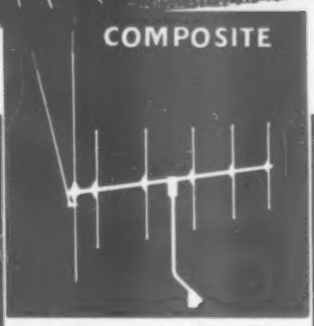
ANTIFERENCE

NEW AUTOMATIC LOFT AERIALS

FOR VERTICAL OR HORIZONTAL CHANNELS

Five-element folded dipole array complete with mounting arm and bracket.

353 32'6



FOR VERTICAL CHANNELS

Band I "V" electronically coupled to 5 Band III elements; complete with mounting arm and bracket.

Independently variable directivity on both bands.

HL523 42'

Optional extra for Band II Addex FM/L 7/6.

FOR HORIZONTAL CHANNELS

HL513 42'

Three-element folded dipole array complete with mounting arm and bracket.

233 35'

THE Vantenna

The ideal "SECOND AERIAL" — enabling the Television Receiver to be used in any room.

Individually packed in an attractive display carton.

Regd. Design No. 888,561

EXPORT RANGE

A specially designed range of T.V. and F.M. aerials, incorporating many new and exclusive features, is available for overseas markets.

★ Horizontally or Vertically Polarized Single or Stacked Yagi Arrays.

★ Broad Band and all-band types for International Frequencies.

★ Models for 75 or 300 ohm inputs.

Supplied only through Antiference Appointed Wholesalers.

FULL COVER including labour charges ANTIFERENCE FREE AERIAL INSURANCE SCHEME Whatever the damage Whatever the cause

ANTIFERENCE LIMITED

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There's MORE SCOPE for the Technical man

IN A R.A.F. SHORT SERVICE COMMISSION*

In this age of missiles, electronics and nuclear weapons, the Royal Air Force offers almost unlimited scope for technical ability. As a R.A.F. Technical Officer you would be a key man in a key branch of the Service, doing work that is absorbing, responsible and, above all, varied.

In fact, if you have recently qualified, a R.A.F. Short Service Commission for 3, 4, 5 or 6 years in the Technical Branch gives greater opportunities for gaining all-round experience than almost any civilian appointment.

Good prospects in the Service—and after

The main need is for electronic engineers and, to a lesser extent, for mechanical engineers. Promotion comes fast in this vital Branch. If you join at, say, 24½ you could be earning £1,250 a year by 30 if married. There are also opportunities of applying for a Permanent Commission; but, if you return to industry, special facilities are available to help you obtain a post in line with your age and added experience. On leaving the R.A.F., you receive a gratuity of £135, free of income tax, for each year served.

THESE ARE THE QUALIFICATIONS You do not necessarily have to be a university graduate; a sound scientific or engineering training is the essential. You must be medically fit and hold, at least, the Higher National Diploma or Certificate in electrical or mechanical engineering, plus G.C.E. at ordinary level in English Language—or equivalent qualifications. You can join as soon as you are qualified, and up to the age of 37 (or 45 if you have previously held a Service Commission).

This is a priority job in a foremost technical service. It offers you valuable experience for your career, excellent pay—and all the wider interests of life as a R.A.F. officer. Write now for full details to Air Ministry (W.D.211), Adastral House, London, W.C.1.

THE ROYAL AIR FORCE

*IF YOU ARE A GRADUATE with a Science or Engineering degree, and under 30, you can apply for a R.A.F. Permanent Commission straight away. Write for details of the fine career prospects and pay offered

STEREO AIRMEC STEREO

Today you can enjoy the ultimate reality of Hi-Fi with this superb

STEREO AMPLIFIER

Designed specifically for the serious stereophonic enthusiast and available at a really competitive price.

10 WATTS OUTPUT ON EACH CHANNEL

No additional pre-amps required.

RETAIL PRICE

£33.10.0

FEATURES FOR THE DISCRIMINATING

- Two identical matched power amplifiers, two identical pre-amplifiers, on a single chassis.
- High sensitivity suitable for all types of high fidelity pickups.
- C core transformers for high efficiency and small magnetic field.
- Switched tone controls for accurate matching between channels, with true "flat" position.
- Separate tone controls for each channel to enable the response of the separate channels to be controlled on monaural sound.
- Separate inputs for pickups, tape decks and radio.
- Recording characteristic correction for 78 and L.P. records.
- Long switch spindles and separate escutcheons to enable amplifier to be built into customers' cabinets.
- Power available to drive tape deck or radio feeder unit.

WRITE FOR LEAFLET

Airmec

STEREO AMPLIFIER

AIRMEC LIMITED : HIGH WYCOMBE : BUCKS

Telephone: High Wycombe 2060

A.T.E. + MARCONI

Combined Operations

The complexity of modern radio-multichannel systems involving hundreds of telephone channels has brought about a collaboration between the two leading specialist organizations in the field—Marconi's in radio, and A.T.E. in carrier transmission.

This completely unified approach to development, systems planning, supply, installation, maintenance of equipment and training of personnel covers radio-multichannel systems in the V.H.F., U.H.F. and S.H.F. frequency bands all over the world.

Full information may be obtained from either:
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND.

or AUTOMATIC TELEPHONE & ELECTRIC CO. LTD., STROWGER HOUSE, ARUNDEL STREET, LONDON, W.C.2

CATHODE RAY TUBE PUMPING

The most modern Pumping Unit manufactured can be used singly (as shown) with Oven movable by counter-balance, or Multi-stage moving automatically through thermostatically controlled oven tunnel.

- ★ *Safety Switch cuts out vapour pump and Isolation Valve should the tube leak.*
- ★ *Thermal Switch cuts off Isolation Valve and Pump Heater should the water supply fail.*
- ★ *Vacuum Reading of tube before seal off, and for checking the Pumping System after refilling.*
- ★ *Indicating Lamps on all Switches for visual notice should cut-outs occur.*
- ★ *Seal Off movement spring assisted. On Multiple Units electric seal-off optional.*
- ★ *We can supply all Auxiliary Equipment for the reconditioning of C.R.T.s.*
- ★ *Demonstrations of completed equipment.*
- ★ *Full Service facilities always available.*

For the Reconditioning of C.R.T.s we supply the complete Outfit as an additional Service to our customers. This equipment can only be purchased with our Pumping Units and is not available for sale on its own.

VACWELL ENG. CO. LTD.

Our Engineers are available to help you, to lay out and to install the required Machinery and our Technical Dept. will assist you in any problems you might encounter in this field.

The Machines are designed to give the maximum protection to themselves and to the goods they produce. We design, manufacture and supply Vacuum Machinery to Major Companies in Gt. Britain and Overseas.

VACWELL ENG. CO., LTD

WILLOW LANE, MITCHAM, SURREY • *Phone MITcham 8211 (3 lines)*

Permanent Magnets

Design Advisory Service

No. 10

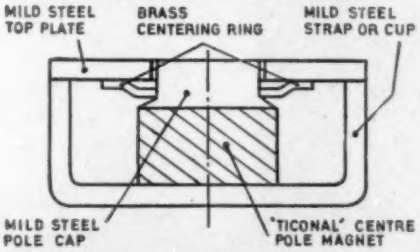
Moving Coil Applications—1

Advertisements in this series deal with general design considerations. If you require more specific information on the use of permanent magnets, please send your enquiry to the address below, mentioning the Design Advisory Service.

The use of modern permanent magnets has resulted in the efficiency of the magnetic systems for moving coil applications being substantially increased during recent years.

The magnet system employed for domestic loudspeakers, which is one of the best known moving coil applications, can be divided into two general types—'centre pole' and 'ring' designs.

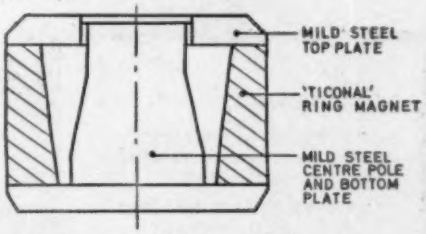
The centre pole design uses a small cylindrical magnet which forms the central pillar of the assembly and is surrounded by a mild steel strap or cup as illustrated. In this design, performance is limited by the size of the magnet which can be arranged within the assembly. If the diameter of the magnet necessitates a collector cap much larger than the one illustrated, the resultant excessive magnetic fringing or leakage will substantially reduce the efficiency of the assembly.



Section of a Typical Centre Pole Moving Coil Strap or Cup Type Assembly. Approximately ½ scale.

An example of the economical use of 'Ticonal' G, the foremost commercial magnet alloy available, is that a magnet with a diameter of 1.14" and height .765", weighing only 3.16 oz., will give a total gap flux of 31,200 maxwells. This is equivalent to an average flux density in a .033" radial air gap of 10,500 gauss, with a mild steel pole diameter of .75" and a top-plate thickness of .187". This represents a magnetic efficiency of 50%.

When higher flux densities in the range of 12,000–17,000 gauss are required, the ring type of assembly is utilised. This type of assembly, which is illustrated, can seldom be designed with an efficiency higher than 30% and is, therefore, not normally used in the design of loudspeakers, where cost is an important factor.



Section of a Typical High Performance Ring Type Moving Coil Assembly. Approximately ½ Scale.

For High Fidelity loudspeakers, where the performance is the most important consideration, and when flux densities in the region of 20,000 gauss are required, the ring type of construction is the only possible solution. However, the following table of leakage factors indicates how rapidly leakage losses increase with increasing gap flux density.

1"	diameter	speech	coil	.045"	gap	up to	12,000 gauss x 3
1"	"	"	"	.045"	"	"	16,000 gauss x 6
1½"	"	"	"	.050"	"	"	16,000 gauss x 6
2"	"	"	"	.050"	"	"	20,000 gauss x 8

Whilst the designs mentioned above are referred to as loudspeaker systems, they are also applicable to many other applications using the dynamic moving coil principle, such as vibrators, punch card pulse actuators, public address pressure units, moving coil microphones, etc.

If you wish to receive reprints of this advertisement and others in this series write to the address below

Mullard

'TICONAL' PERMANENT MAGNETS
'MAGNADUR' CERAMIC MAGNETS
FERROXCUBE MAGNETIC CORES

MULLARD LIMITED, COMPONENT DIVISION, MULLARD HOUSE, TORRINGTON PLACE, W.C.1. LANgham 6633

MC371A

Now A VALVE VOLTMETER FROM Advance

With these
OUTSTANDING FEATURES

EXTREME SENSITIVITY
accurate measurements are possible down to 100μV.

WIDE VOLTAGE RANGES
1mV. to 300 volts F.S.D.

WIDE FREQUENCY RANGE
15c/s to 4.5Mc/s accuracy ± 2dB

METER SCALE CALIBRATED IN VOLTS AND dB

CAN BE USED AS A NULL DETECTOR AND INDICATOR
from 10c/s to 10Mc/s

CAN BE USED AS AN AMPLIFIER FROM 10c/s to 10Mc/s

INCORPORATES ITS OWN H.T. STABILIZER

SMALL COMPACT SIZE & ROBUST CONSTRUCTION

at this price . . .

£50 nett in U.K.

(including very low capacity screened lead and probe)

with this backing . . .

Behind this, the most modern instrument in its sphere, is that specialist instrumentation skill and experience which has earned for all "Advance" products a reputation second to none throughout the industry. From our up-to-the-minute factory at Hainault comes this latest addition to the world-famous "Advance" range of instruments.

Full Technical details in Leaflet W30

THE Advac

Size 4¾" x 7½" x 6¾"
Weight 7lb.

Advance COMPONENTS LIMITED

ROEBUCK ROAD · HAINAULT · ILFORD · ESSEX · TELEPHONE: HAINAULT 4444

VISIT US ON STAND 31, The PHYSICAL SOCIETY EXHIBITION, Royal Horticultural Hall, London, Jan. 19th to 22nd

... till you've heard

a TRUVOX

R2 TAPE RECORDER

From the very first replay—pre-recorded or your own home-recorded programme—you'll be thrilled with its sureness of tonal quality and ease of control. Just as you recognise the voice of a friend on the 'phone or your favourite songster on radio or record, you'll know that this is the instrument you've always wanted. Designed and built by pioneers in the development and manufacture of Tape Decks and Tape Recording Amplifiers—TRUVOX are justly proud of an instrument that lives up to "all that the name implies." Increased production at our new, modern factory now enables us to offer this famous instrument at reduced prices—Models now available from **56 gns.**

CREDIT TERMS ARE AVAILABLE THROUGH MOST DEALERS

★ GO STEREO with TRUVOX

Truvox Tape Recorders can now be supplied fitted with a stereophonic head at extra cost—add a second loudspeaker and amplifier and you can enjoy all the thrills of stereophony in your own home.

Available from all leading stores and radio dealers or full details from:—

TRUVOX Stereophonic Head for replay of pre-recorded stereophonic tapes.

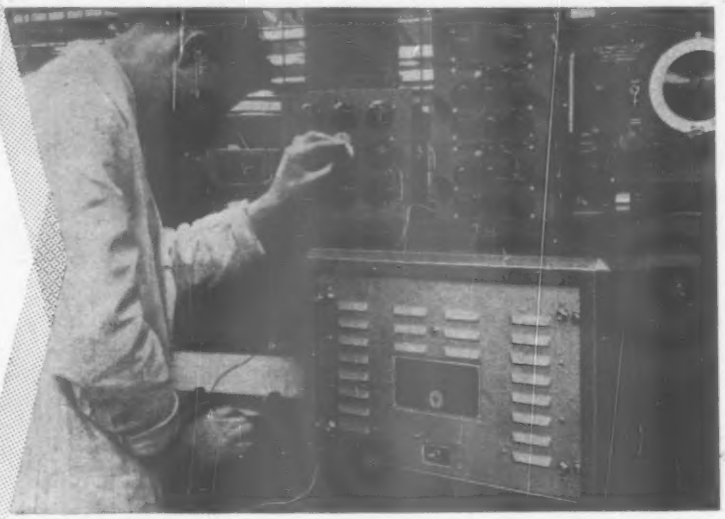
TRUVOX RADIO JACKS direct radio reception and recording.

TRUVOX TELEPHONE ADAPTOR for 2-way telephone conversation recording.

TRUVOX LIMITED, NEASDEN LANE, LONDON, N.W.10 Telephone: Gladstone 6455

IF YOU NEED VOLTAGE REGULATION—YOU NEED **SORENSEN**

Voltage Regulation in the field of Precision Engineering



The Short General Purpose Analogue Computer, produced by Messrs. Short Brothers & Harland at their Castlereagh factory, is the first of its kind to be designed for general application to industrial problems. It is capable of solving in a very short time, complex mathematical problems which would normally take several days to calculate on paper. Each computer is carefully tested at Castlereagh and to ensure complete accuracy, Sorensen a.c Voltage Regulators are used to stabilise the voltage to each computer whilst under test.

Reliability—exceptional accuracy—frequency insensitivity—negligible distortion—fast response time—no load to full load performance—Sorensen a.c Voltage Regulators 150 VA to 15 KVA are available in sub-unit, rack mounting, cabinet, and tropicalised forms.

CALL IN JLT GROUP

Write for full details

SORENSEN DIVISION

JLT GROUP **J. LANGHAM THOMPSON LTD.**

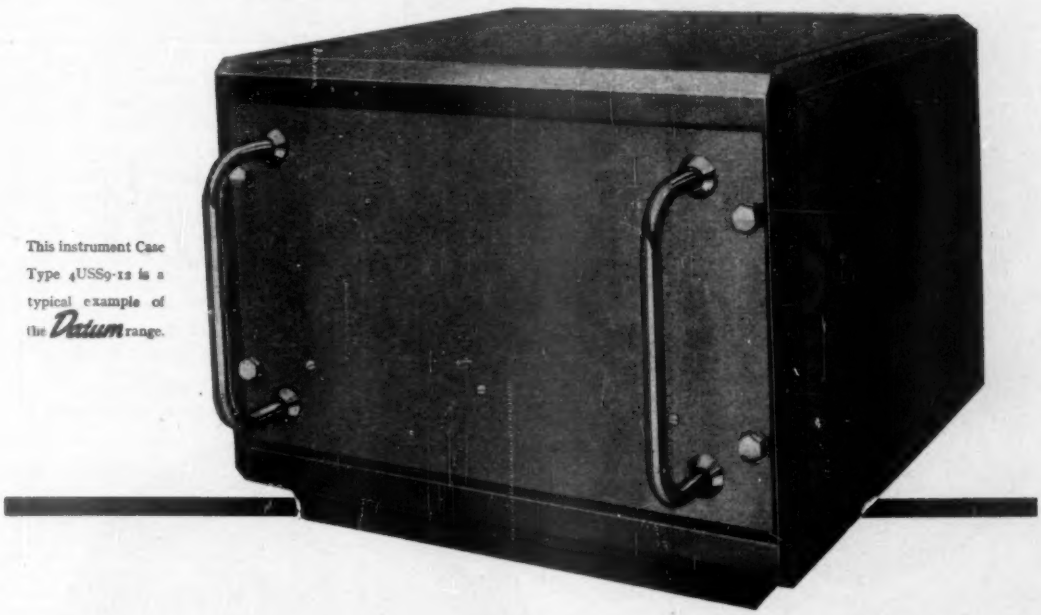
BUSHEY HEATH · HERTFORDSHIRE · ENGLAND

Telephone: BUShey Heath 2411 (4 Lines) Grams & Cables: "Tommy Watford"

Make Datum Regd. your starting point

DATUM cases have been designed by electronic engineers to house electronic equipment, they are therefore both functionally and attractively styled.

A wide selection of standard sizes is available permitting the housing of many different types of equipment. We are however prepared to fabricate cases to suit customers' specific requirements where this is both desirable and necessary.



This instrument Case Type 4USS9-12 is a typical example of the Datum range.

Send for the Datum Regd. Catalogue today

DATUM CASE FEATURES

- STACKABILITY
- STRENGTH WITH LIGHTNESS
- VENTILATION

DAVIS & THOMPSON LTD.

WATFORD BY-PASS, WATFORD, HERTFORDSHIRE.

Telephone: Watford 6566. Telegrams: "Datum Watford"

JLT GROUP

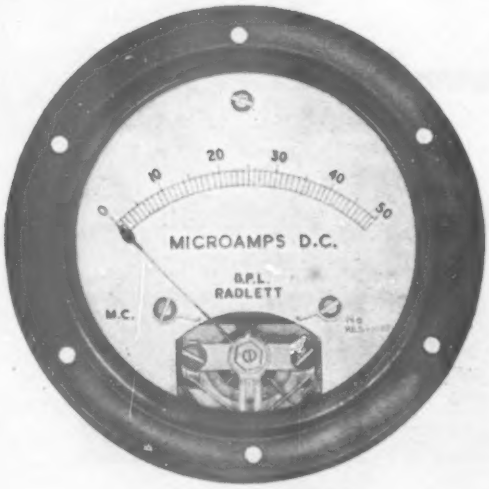
AD/D7

BRITISH PHYSICAL LABORATORIES

H.15 (1½") to SRDE prov 230/1 (components)—hermetically sealed.

MAKERS OF *Hermetically sealed Meters*

H.25 (2½") Dimensions conforming to RCS231 and hermetically sealed.



British Physical Society Exhibition
STAND No. 28
ROYAL HORTICULTURAL OLD HALL, VINCENT SQUARE, S.W. 1
19th-22nd January, 1959

MANUFACTURERS OF METERS OF ALL TYPES WITH SCALE LENGTHS VARYING FROM 1½" to 18".

RADLETT · HERTFORDSHIRE · ENGLAND

TELEPHONE RADLETT 5674

High Fidelity at Realistic Cost

STENTEREO

STEREOPHONIC SPEAKER SYSTEM

(Pat. App. 33293/58)

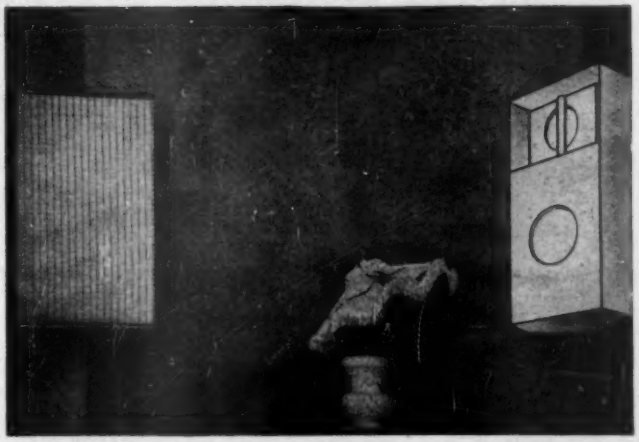
This system consists of two corner loudspeaker enclosures which embody many novel features. The enclosure is divided into two sections, the lower section taking the form of an infinite baffle. Into this may be fitted a W.B. Stentorian Loudspeaker, type H.F.810 or H.F.812, to provide the lower and part of the middle register of sound.

For the upper and the remainder of the middle register a W.B. Stentorian Loudspeaker type S.510 is used, and the two units are coupled by means of a crossover unit type CX.1500.

Provision is made in the upper section of the cabinet for rotating the baffle by the listener to give the best stereo effect.

A single cabinet with loudspeaker may be used for single channel listening.

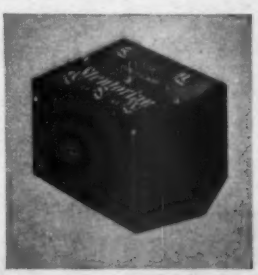
Corner Cabinet £7·10·0
Plinth for floor mounting 17/- extra



The complete system costs less than £30

H.F.810 and H.F.812
These are both 8" Units, with a handling capacity of 5 watts. Frequency response, 50 c.p.s. to 13,000 c.p.s. Bass resonance, 45 c.p.s.

H.F.810 incorporates a 10,000 gauss magnet and has a steel chassis. **£3.2.0** (inc. P.T.).



H.F.812 incorporates a 12,000 gauss magnet, is fitted with cambric cone and universal impedance speech coil, and has a die-cast chassis. **£4.3.6** (inc. P.T.).

S.510 is a 5" unit, with a 10,000 gauss magnet. **£2.2.0** (inc. P.T.).

CX.1500 Crossover Unit. Filter type crossover network, 1,500 c.p.s. **£1.18.3.**

Demonstrations at all leading Hi Fi dealers and at our London Office (109 Kingsway, W.C.2) every Saturday from 9 a.m. to 12 noon. Descriptive leaflets on all products free on request.

W.B. STEREO COLUMNS

The floor area occupied is much smaller than that for two conventional cabinet speakers of similar performance. Columns have 360° diffusion by means of a dome mounted above the loudspeaker. One unit may be used for monaural sound and a second for stereo.

"SENIOR" for 8" unit - - **£18.18.0**
H.F.816 Unit £6.17.0
"JUNIOR" for 6" unit - - **£9.19.6**
H.F.610 Unit £2.11.6
or **£2.13.6**

Stentorian

WHITELEY ELECTRICAL RADIO CO. LTD · MANSFIELD · NOTTS

LOW NOISE TRANSISTOR GET106

This device is a p-n-p germanium junction transistor made by an alloy process. Its extremely low noise level is lower than any other type of transistor commercially available in Great Britain at present.

Typical noise factor 3 db.

Typical operating conditions as audio frequency pre-amplifier (common emitter)
Collector voltage 6 V. Load resistance 1 KΩ.
Collector current 1 mA. Source resistance 600Ω.
Power gain 33 db.
Input signal (over frequency range 10 c/s. to 10 kc/s.) required to give 20 db. signal/noise ratio; 7 μV. or 5 mμA.

The GET106 replaces the GET6, but with reversed connections

Full details of this and other semi-conductor devices manufactured by the G.E.C. are available on request from the Valve and Electronics Department.

G.E.C. TRANSISTORS

THE GENERAL ELECTRIC COMPANY LIMITED MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

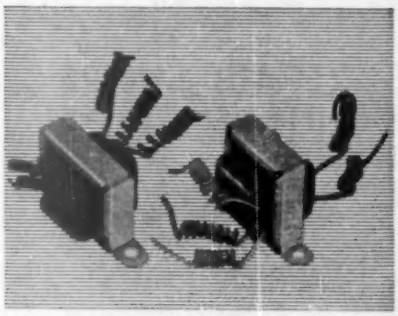
If it's Electronic . . .

and you want it Designed and Developed or Produced to your Specification*

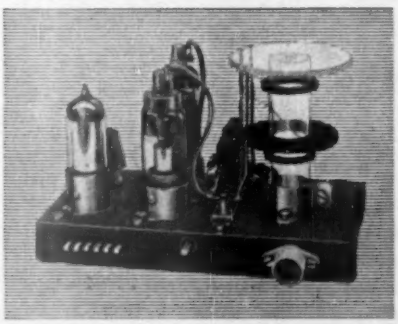
Consult

P·A·M·LTD

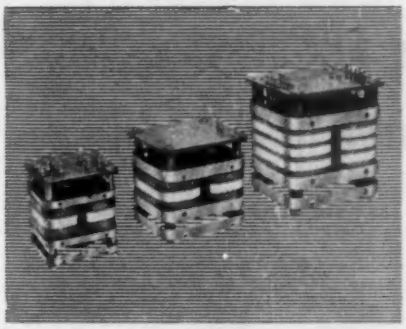
*Whichever stage of the struggle you've reached, we can save you time and trouble—maybe money too—write or 'phone without delay.



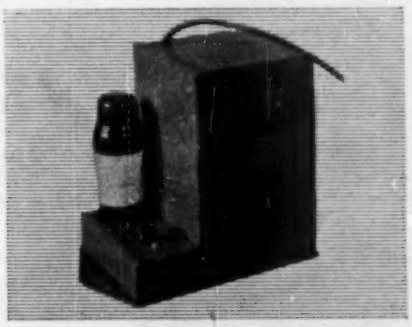
These are typical examples from our range of miniature Transistor Transformers suitable for 250mW output. Both driver and output types are shown. Dimensions are 1⅛"×⅝"×⅝". Enquiries are invited for the manufacture of quantities of transformers to individual requirements.



Compact Stabilised High Voltage Supply. Safe and reliable supply for photo-multiplier cells and cathode ray tubes. Variable output between 0-1250V D.C. at 250 micro amps. Size 6"×4"×3".



These open type C core chokes and transformers are further examples of the wide range of transformers we design and make in quantity to individual customer's requirements.



R.F., E.H.T. Unit. A safe, D.C. high voltage unit specially designed to meet the need for a reliable source of supply for television C.R. tubes. Also satisfactory for flash testing where a D.C. supply is necessary.

P.A.M. LTD. Electronics Department combines the technique of several companies, long established in the Electronic field, with the extensive modern production resources of P.A.M. LTD.

Examples of recent work are illustrated

P.A.M. LIMITED *Electronics Department*

MERROW · GUILDFORD · SURREY

Telephone: Guildford 2211

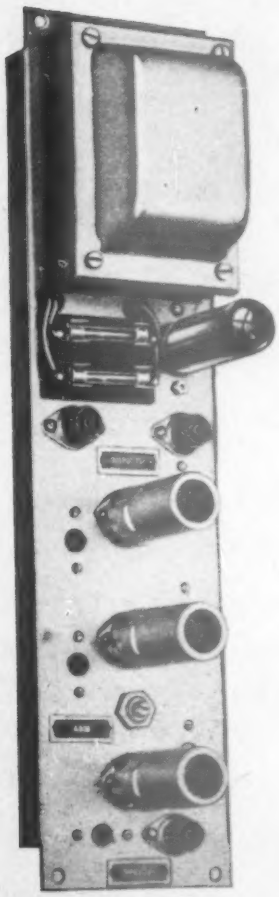
ONE OF THE GROUP OF COMPANIES ASSOCIATED WITH THE SOUTHERN AREAS ELECTRIC CORPORATION LIMITED

A New Departure in T/V Amplifier Design . . .

TELENG

DOUBLE CHANNEL AMPLIFIER

TYPE U30 D



A Television Boost Amplifier for

SHOWROOMS, REPAIR SHOPS or COMMUNAL AERIAL SYSTEMS

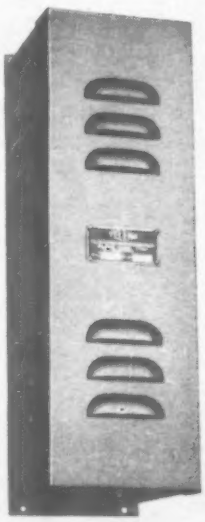
The U30D Amplifier has been so designed to use the same valves for two channels. This results in a high gain unit, equal in every way to two separate amplifiers and at a price comparing more than favourably with even the cheapest single unit.

TECHNICAL DETAILS

Gain 30 db on each of any two channels to your choice in Bands I and 3. Internally combined output up to 150 m/V each channel for up to 40 outlets.

Net Trade Price £15

For V.H.F.—the U30 FM at £14 net trade, matches and couples to the U30D without external combining units and losses.



HOUSED IN STRONG METAL CASE

Write for fully descriptive leaflet to :—

TELEFUSION ENGINEERING LTD.

ONE OF THE TELEFUSION GROUP OF COMPANIES

Teleng Works, Church Road, Harold Wood, Romford, Essex *Ingrebourne 42901*

Transistor News

Important News for Radio Manufacturers

The 'CIRCLE LINE'

Newmarket introduces matched sets of transistors for better performance

Newmarket, Monday.

This is news that no radio manufacturer can afford to ignore—transistors in matched sets, or complements, at really competitive prices. A choice of 5 different complements is available, each complete with diode, to suit any conventional circuit arrangement.

Cheaper all-transistor radios

This bold step forward should give a tremendous fillip to the mass production of transistorized radios.

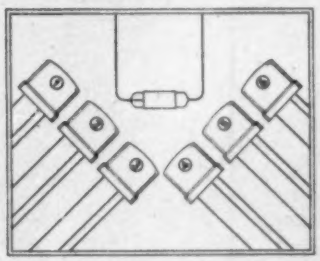
Combined performance is what counts

Newmarket Transistors Limited, pioneers of transistor development in Britain, have the advantage of more than 3 years' experience both of transistor production and of the problems associated with design and production of equipment incorporating them.

This experience has shown that the maintenance of adequate performance standards depends as much upon the combined performance of the transistor complement as on the performance of individual transistors.

New coloured circle coding

To distinguish these 'Circle Line' complements Newmarket have replaced their conventional type numbers by a new colour-coding system, in which a coloured circle denotes the particular series or complement and a number within the circle indicates its position in the circuit.



The following is a typical example:

White Circle 6

1	2	3	4	5	6
Osc/mixer	IF	IF	driver	O/P	O/P

(plus detector diode)

The range of Circle Lines at present available is as follows:

Red Circle 5

For pocket receivers with 6v supply. Five transistors numbered from 1 to 5 in RED.

White Circle 6

For handbag style receivers, 6v or 9v supply. Six transistors numbered 1 to 6 in WHITE.

Blue Circle 7

For handbag or general-purpose portable, 6v or 9v supply. Seven transistors numbered 1 to 7 in BLUE. Average stage gain lower than White Circle but overall performance better.

Green Circle 7

Similar to Blue Circle but one IF stage replaced by an audio stage.

Yellow Circle 8

For larger portables and domestic receivers where performance is of first importance. 6v or 9v supply.

Reliability of Supply

Replacements are only a minor problem in Transistor Receivers but every possible provision has been made to ensure replacement availability. When re-ordering, Circle colour and number only need be given. Prompt deliveries in almost any quantities can be guaranteed.

NEWMARKET TRANSISTORS

All enquiries to:

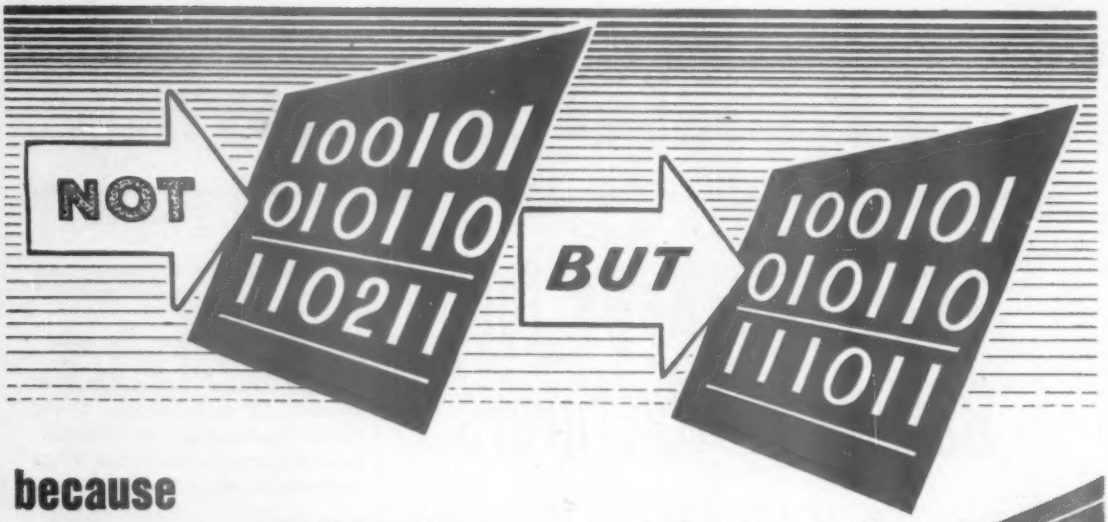
Newmarket Transistors Limited

Exning Road, Newmarket, Suffolk

Tel: Newmarket 3381

Cables & 'grams: Semicon Newmarket.

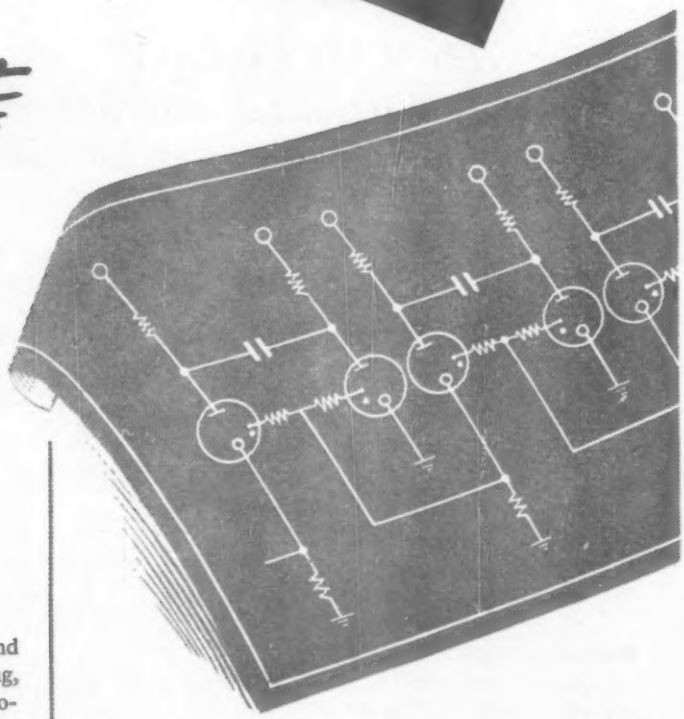
D1641



because you can count on

HIVAC

Cold Cathode Tubes



IN ADDITION to cold cathode diodes and triodes for decimal or binary counting, storing, gating, switching, etc., HIVAC products include directly and indirectly heated subminiature valves, neon indicator lamps, specialised filamentary indicator lamps, telephone switchboard lamps and transistors.

Our Technical Service Department will be pleased to supply further information and assist in any problems arising from the use of Hivac tubes.

Hivac Limited

A member of the Automatic Telephone and Electric Group

STONEFIELD WAY, SOUTH RUISLIP, Middx.

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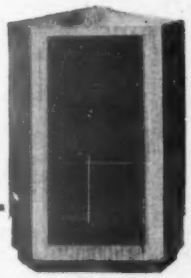
Todays most Brilliant 25 watt Hi-Fi Systems

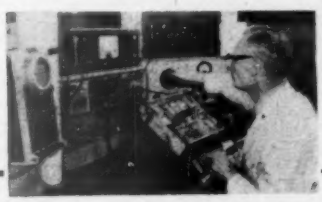


Model HF25SCA

The new Pye De Luxe 3-Speaker System

Fine walnut veneered cabinet houses a 15" bass unit, a mid-range unit and a 4" tweeter. Frequency range: 20-20,000 c.p.s.

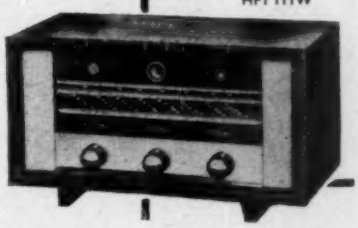
Today, the design and manufacture of high fidelity equipment is a specialist business, calling for knowledge and techniques of the highest order. The Pye system featured here was produced in our High Fidelity Division —an organisation devoted solely to the production of equipment of this type—and is recog nised to be one of the finest available in its power rating.



The Pye FM/AM Tuner

Built-in power pack; 8 valves; A.G.C. on both AM and FM; stabilised permeability tuning; phase discriminator; attenuators for AM and FM outputs. Copper finished control panel.

Model HFT 111W

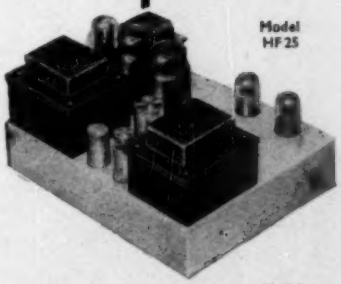


Special Collaro Type 4T200 Transcription Units finished in matching copper colour are available.

The Provost 25-watt Amplifier

A frequency coverage of 2-160,000 c.p.s. with infinite damping factor.

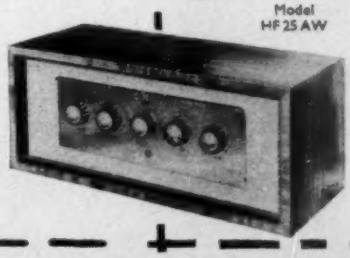
Model HF25



The Proctor Control Unit

Provides smooth, highly flexible controls and facilities for four inputs; 5 types of pick-up compensator; selector, bass, treble and filter controls. Copper finished control panel.

Model HF25AW



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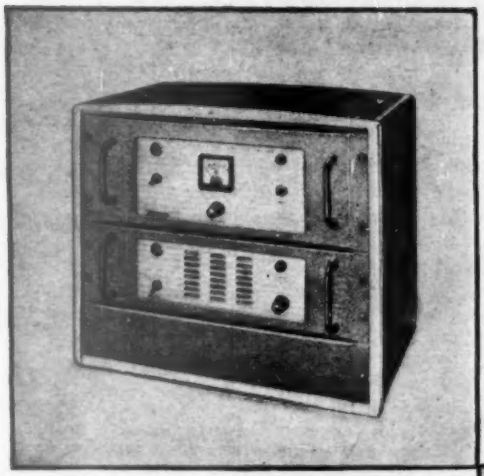
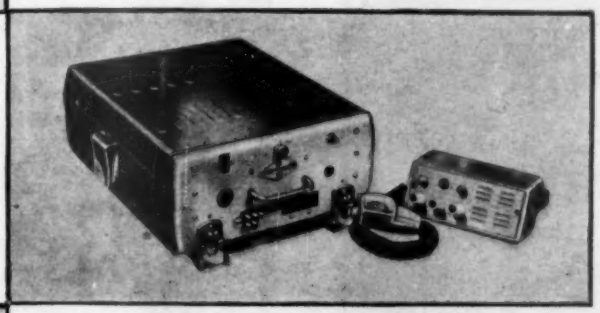
Photography by Heal & Sons Ltd.



BY APPOINTMENT TO H.R.H. DUKE OF EDINBURGH SUPPLIERS OF RADIO TELEPHONE EQUIPMENT PYE TELECOMMUNICATIONS LTD.

ANNOUNCING THE LATEST RANGER RADIOTELEPHONE

A complete series of fixed and mobile equipment AM or FM



MAIN FEATURES:

- Available from 25 Mc/s to 174 Mc/s.
- F.M. or A.M. simplex or duplex
- Low battery drain
- Split-channel selectivity
- Unit chassis construction
- Up to 6 switch-selected channels
- Light weight
- Low cost installation and maintenance

The following features are optional:

Channel spacing. A.M. Type V: 20, 25, 30 kc/s. Type N: 40, 50, 60 kc/s; Type W: 100 kc/s or greater. F.M. Types: 40, 50 or 60 kc/s. Public address and Rebroadcast facility on A.M. Types. Fist microphone or telephone handset.

Mobile Range Equipment

PTC 2001/2	5 watt	A.M.	Dash-Mounted Unit
PTC 2101/2	5 watt	A.M.	Boot-Mounted Unit
PTC 2201/2	15 watt	A.M.	Boot-Mounted Unit
PTC 8001/2	100 watt	F.M.	Dash-Mounted Unit
PTC 8101/2	10 watt	F.M.	Boot-Mounted Unit
PTC 8201/2	20 watt	F.M.	Boot-Mounted Unit

Fixed Stations

PTC 752/4	15 watt	A.M.	Fixed Station
PTC 753/4	50 watt	A.M.	Fixed Station
PTC 8701/2	20 watt	F.M.	Fixed Station

PYE TELECOMMUNICATIONS LTD.
NEWMARKET ROAD
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Telephone: TEVERSHAM 3131
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PYE

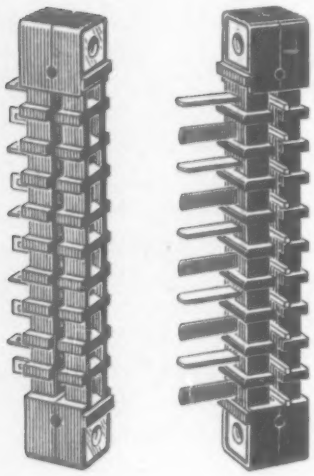
All Ranger Mobile Models are available for 6, 12 or 24 volts power supply.

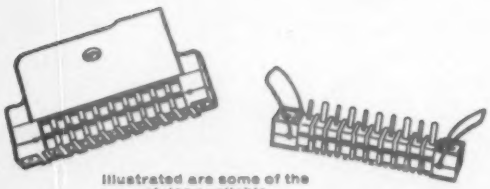
Please write for further details

PAINTON

THE NEW "MICROCON" PRINTED CIRCUIT CONNECTORS

Microcon Printed Circuit Connectors are designed to meet the requirement for a light, compact, multi-way plug and socket, giving greater reliability and longer life than the edge connector method. Other patterns will soon be available, as well as the ten-way connector shown here.





Illustrated are some of the styles available

The pitch of soldering tags is suitable for a board punched to a standard module of 0·1".

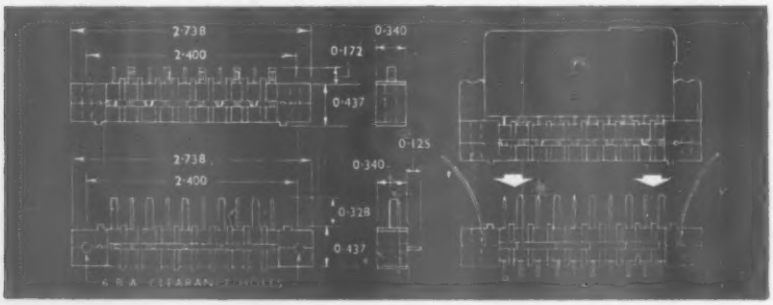
Two types of plug are available—the first has the solder tags orientated at 90° to the contact blades, the second has solder tags that are a continuation of the blades.

A metal cover can be fitted to either the plug with the straight blades or to the socket, and the mating unit can be supplied with wire retaining loops.

The two-part diecast cover, whose inner surfaces are insulated against short-circuiting, allows the connections to be checked physically and electrically without disturbing the clamping of the cable.

For polarizing purposes, when several connectors are mounted in close proximity, one or more contacts can be removed from each plug in various combinations, the corresponding contact in the mating socket being blanked off by special polarizing keys.

Write for technical leaflet



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SOME OVERSEAS TERRITORIES STILL AVAILABLE

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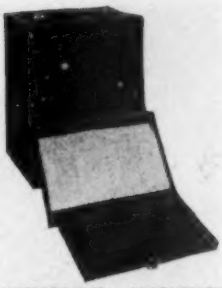
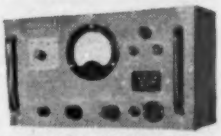
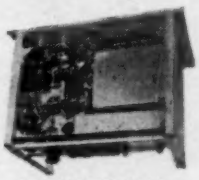
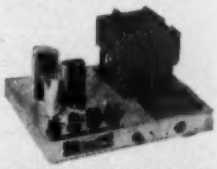
Cables: "TELESET," HYTHE, SOUTHAMPTON.

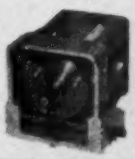

HETERODYNE FREQUENCY METERS. 20 MC/S.-1,000 MC/S. RE-CONDITIONED & CALIBRATION CHECKED B.C.221's. FREQUENCY METER STABILIZED POWER UNITS.


HIGH VOLTAGE INSULATION TEST SET—1-15 K.V.


MARINE BROADCAST RECEIVERS

625 LINE PROJECTION T/V.


STABILIZED POWER SUPPLIES.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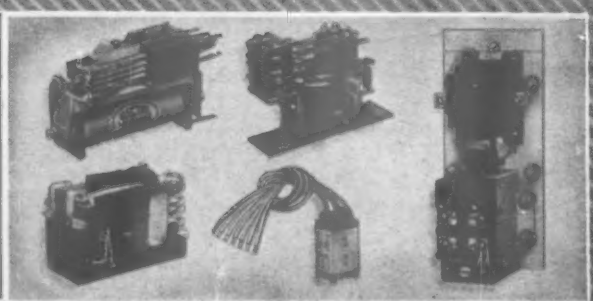

ELECTRO-METHODS LTD. 12-36 CAXTON WAY, STEVENAGE, HERTS. Phone: STEVENAGE 780

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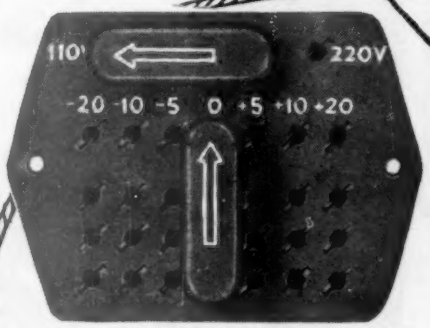
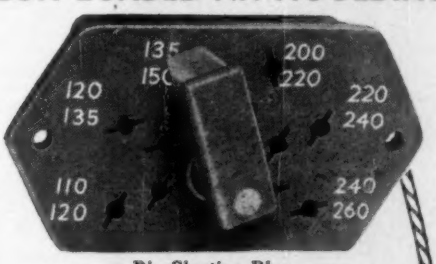
McMURDO
Multi-Way Voltage Selectors

14 WAY
Type B279001
BLACK P.F. MOULDING



4 Pin Shorting Plugs

6 WAY
Type XVS/6
NYLON LOADED P.F. MOULDING

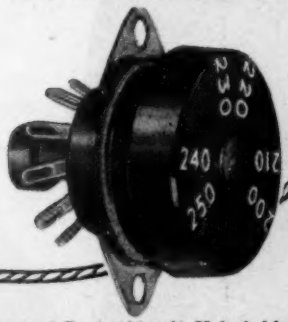


3 Pin Shorting Plug

4 WAY
Type BVS/4
BLACK P.F. MOULDING

3 Pin Shorting Plug

6 WAY
MINIATURE
Type BMVS/6
BLACK P.F. MOULDING



Standard B9A (Noval) Valveholder with 2 Pin Captive Shorting Plug

Send for full details to :—

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MV515

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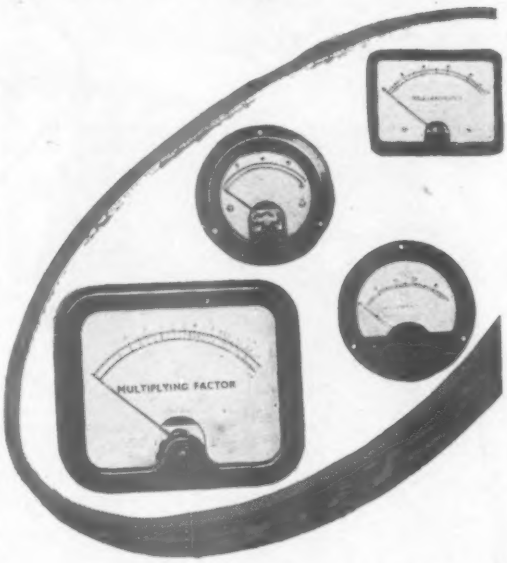

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Meters, Electronic & Test Equipment to individual specifications.

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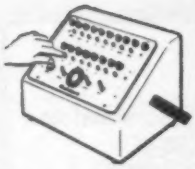

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NO LOUDSPEAKERS, BELLS or FLASHING LIGHTS
only the man who's wanted knows and replies.

Selective Induction is saving time, money and worry in Offices, Factories, Hospitals, Hotels, Departmental Stores etc., all over the Country. All key personnel carry small transistorised receivers bearing a number. When they are wanted their numbered key is pressed on a small transmitter. Immediately they must respond to the URGENT 'PEEP PEEP' in their pockets which summons them and them alone to ACTION! A verbal message can be transmitted if desired.

- Covers areas indoors or out, up to 10,000,000 sq. ft.
- Designed for the man who cannot afford to be tied to his office.
- Equally suitable for large or small concerns.
- Low purchase price—virtually no indoor wiring—low rental terms.

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(the 'Peep Peep' in the Pocket)

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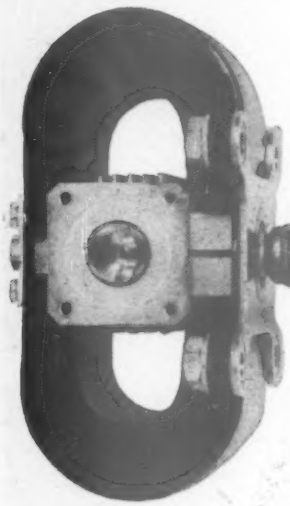
For large sets . . .

A line-up of large radar valves specially designed to provide high performance and reliability at a very competitive price.

Valves for Marine

80kW



Magnetron JP9-75
Unlike other magnetrons of similar ratings, the JP9-75 is specifically designed for marine installations with subsequent suitability and economy. It provides highly stable pulse operation with pulse durations of 0.1 and 1.0 microsecond and will deliver peak output powers of up to 80 kilowatts. Frequency is within the range 9345 to 9405 Mc/s.

Pulse Modulator XH8-100 (CV1787)
Hydrogen-filled pulse modulator with a peak cathode current of 90 amps. Directly equivalent to the American 4C35.

Klystron KS9-20A (CV2792)
Mechanically tuned reflex klystron directly equivalent to the American 2K25. Frequency range 8500 to 9660 Mc/s.

Pulse Modulator QV20-P18 (CV2752)
Vacuum pulse modulator with a peak anode current of 18 amps. Directly equivalent to the American 4PR60A.

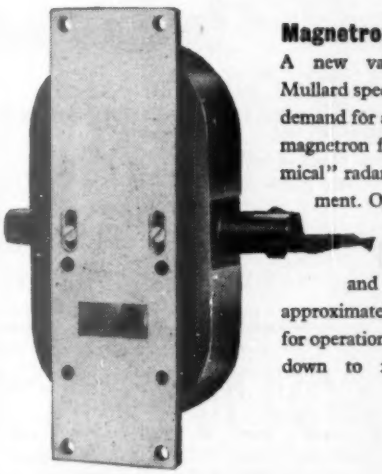
The valves in this advertisement are not shown to scale.

Radar

For small sets . . .

This Mullard line-up of radar valves is designed to achieve the maximum economies in power consumption and in the cost of associated components — both essential requirements in small ship installations.

3kW



Magnetron JP9-2.5

A new valve designed by Mullard specifically to meet the demand for a low power pulsed magnetron for use in "economical" radar navigation equipment. Operating frequency within the range 9345 to 9475 Mc/s and peak output power approximately 3 kW. Tested for operation with pulse lengths down to 20 millimicrosecs.

Pulse Modulator EL360

Another Mullard development. This vacuum pulse modulator is recommended for operation with the JP9-2.5 magnetron. Maximum peak cathode current 4.0 amps.

Klystron KS9-20 (CV1795)

Mechanically tuned reflex klystron directly equivalent to the American 723A/B. Frequency range 8702 to 9548 Mc/s.

Abridged guide to Mullard Valves for Radar

Please write to the address below for further information.

	Mullard No.	Services No.	American No.
Magnetrons	JP8-02	—	—
	JP9-01	—	—
	JP9-2.5	—	7028
	JP9-7	CV3676	2J42
	JP9-7A	CV370	—
	JP9-7B	—	—
	JP9-7D	CV1866	—
	JP9-15	CV3997	2J42A
	JP9-75	—	6972
	JP9-60	CV3569	4J52
	JP9-80A	CV5018	4J52A
	JP9-250	CV2284	4J50
	JP9-250A	CV3953	4J78
	JP16-40	—	—
	JPT6-01	—	—
	JPT8-01	—	—
	JPT9-01	CV2420	—
	JPT9-02	CV2421	—
	JPT9-60	CV3560	2J51A
Hydrogen-filled Pulse Modulators	XH3-045	CV372	3C45
	XH8-100	CV1787	6268 / 4C35
	XH16-200	CV2520	6279 / 5C22
	XH25-500	CV3521	5949
Vacuum Pulse-Modulators	EL360	—	—
	QQV5-P10	CV2295 / CV3599	3E29
	QV10-P8	—	—
	QV20-P18	CV2752	4PR60A
	QY550-P40	CV313	—
Klystrons	KS7-85	—	2K26
	KS7-85A	—	5976
	KS9-20	CV1795	723A/B
	KS9-20A	CV2792	2K25
	KT9-150W	—	—

HVT 354a

Mullard

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LONDON · W.C.1
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Mullard
GOVERNMENT AND INDUSTRIAL VALVE DIVISION

MAXI-Q REGD

TRANSISTOR COMPONENTS

IFT.13, MINIATURE 1st and 2nd I.F. TRANSFORMER, 7/6 each.
These transformers are wound in ferrite pot cores with an adjustable core for tuning. The aluminium screening can measures 17/32in. × 11/16in. high and is provided with two fixing clips. Nominal frequency: 470 kc/s. Q=110.

IFT.14, MINIATURE 3rd I.F. TRANSFORMER, 7/6 each.
Construction and dimensions as IFT.13. Nominal frequency: 470 kc/s. Q=130.

TOC.1, MINIATURE TRANSISTOR MEDIUM WAVE OSCILLATOR COIL, 7/6 each. Construction and dimensions as IFT.13. For use with FSA.1.

PRINTED CIRCUIT CHASSIS, punched complete, 8/-.

FSA.1, MEDIUM WAVE FERRITE SLAB AERIAL, 6/6 each.
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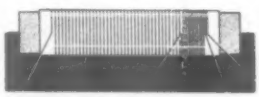

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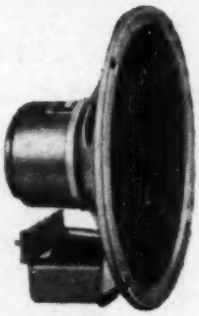

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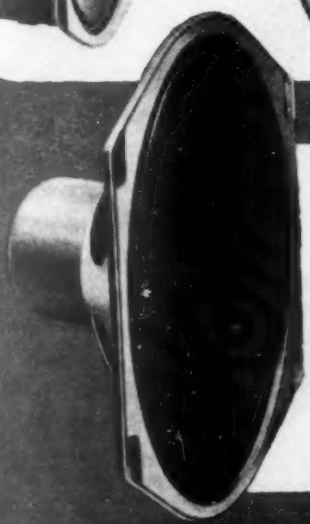

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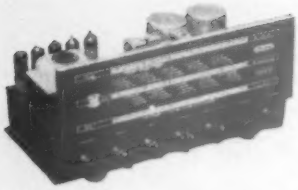
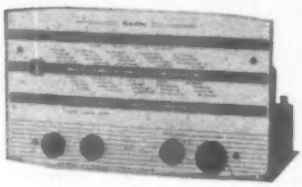


A RANGE TO CHOOSE FROM



STEREO-TWELVE CHASSIS 37 GNS

The most complete unit yet produced for Stereo giving 6 watts high fidelity push-pull output on each channel. Full VHF band, medium and long wavebands. Stereo and monaural inputs for records, tape and radio and a tape output for stereo and monaural tape recording. Comprehensive matching for all types of crystal pick-ups.

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Armstrong

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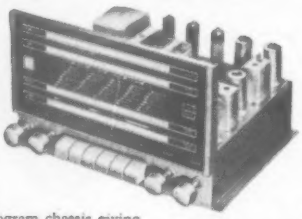
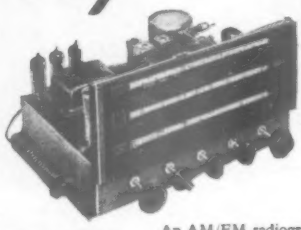


A nine valve AM/FM radiogram chassis giving 6 watts push-pull output and fitted with attractive piano key selectors. Covers full VHF band, medium, long and short wavebands and an output socket is provided for tape recording from radio and pick-up. Can be adapted for stereo at any time by the addition of our compact easy-to-fit converter amplifier.



JUBILEE CHASSIS 29 GNS

An AM/FM radiogram chassis with nine valves and two diodes and with push-pull output stage providing 6 watts. Full VHF, medium and long wavebands with automatic frequency control on FM and ferrite aerial on AM. Tape record and playback facilities. Can be adapted for stereo at any time by the addition of our compact, easy-to-fit converter amplifier.

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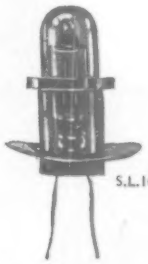

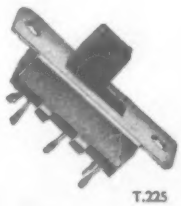

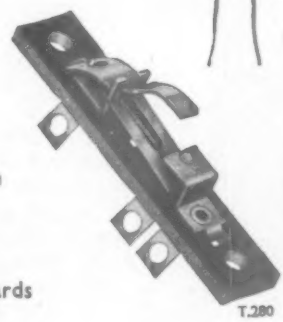

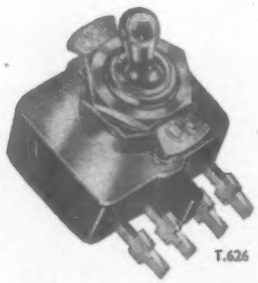

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C1133 (CV2416)	4PR60A 715C CV427 CV2752	152 mm	65 mm	9 oz.	26	20 kV	25 kV	18 A	1500 V	60 W
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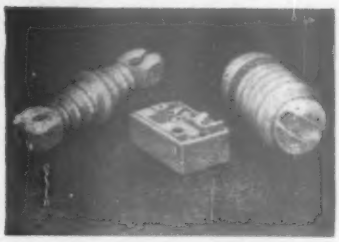

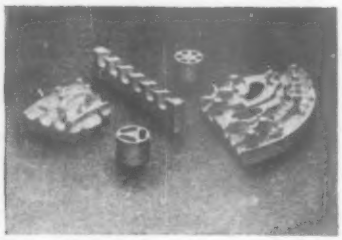

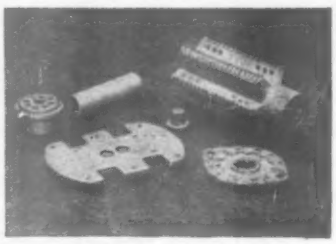

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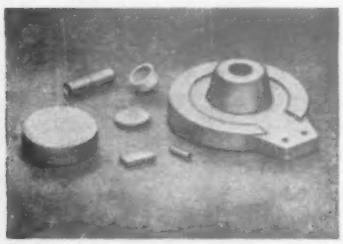

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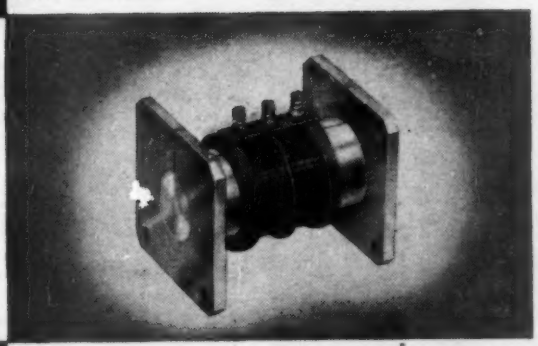

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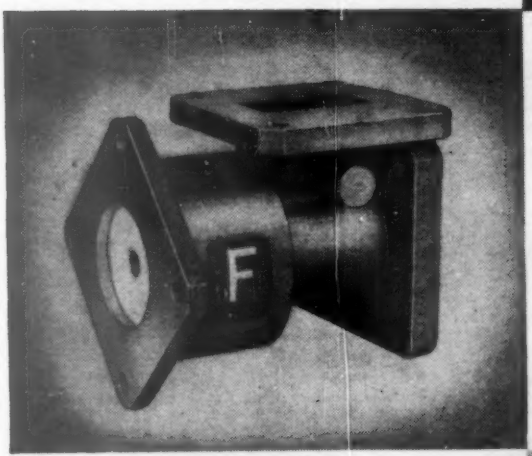

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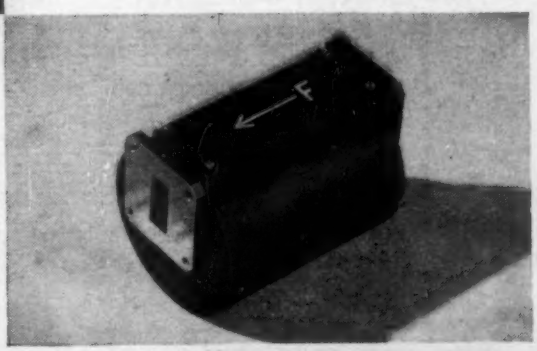
Isolation in both cases greater than 20 db over a band width of 1000 mc/s with an insertion loss of less than 1 db.



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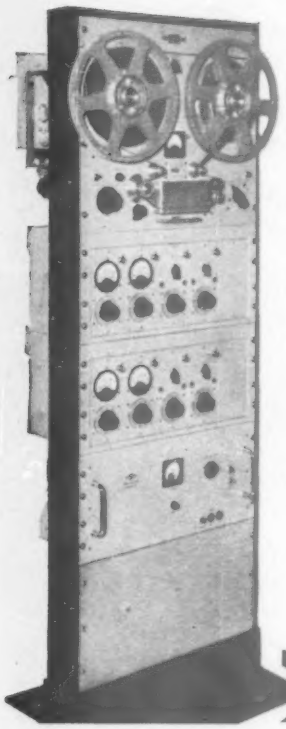

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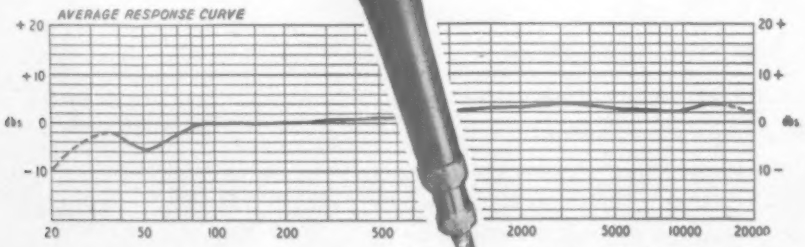
Low, medium or high impedance models are available together with a complete range of stand adaptors, stands, swivel holders, and switch assemblies. *Pack consists of Microphone (low impedance) with lead and plug, holder and swivel, adaptor and base. Weight complete in box, 2lb. 9 oz. (1.16 kilo). Size 10¼×5×2¾in.*



Output levels:
25 ohms—86 db below 1 volt/dyne/cm.²
600 ohms—70 db below 1 volt/dyne/cm.²
50,000 ohms—52 db below 1 volt/dyne/cm.²

Weight of Hand Microphone 7¼ oz.
Length of Hand Microphone 8¼in.
Diameter overall 1⅛in.

Grampian

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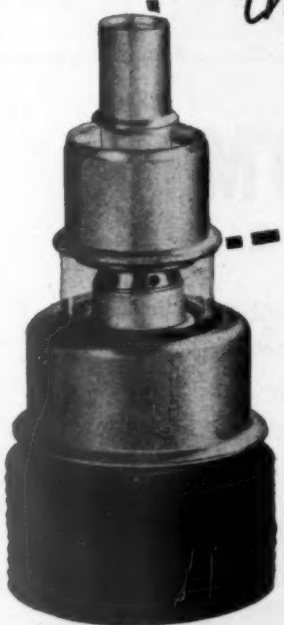

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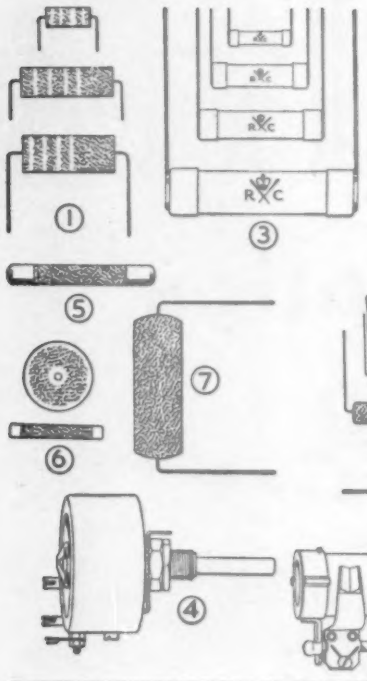

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1. Solid	½ 1 & 2	10—10M	5% & 10%
2. Cracked	1/30—20	1—500M	5% & 10%
3. * High Stability	1/10—3	1—50M	0.5% 1% 2% 5%
4. Variable	½—3	5K—2M	—
5. V. High Resistance	½—3	50M—10¹³	5% & 10%
6. V.H.F. (Rods & Discs)	1/10—1	10—1K	1% & 2%
WIREWOUND			
4. Rheostats	4—500	10—80K	—
9. Sliders	3—15	10—16K	—
8. Vitreous	3—500	1—150K	1% 2% 5%
7. Cemented	1—15	1—25K	5% & 10%

* The ubiquitous blue (1%) grey (2%) "HISTABS"

Do you KNOW
THAT V.H.F. rods and discs (5) can be supplied in matched pairs.

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GL58 (less cartridge) *£15.0.0.* Plus *£5.17.0* • GL58/580 (fitted with the new Goldring 580 cartridge) *£19.4.0.* Plus *£7.9.9.* • GL58/600 (fitted with the Goldring No. 600 cartridge) *£23.8.0.* Plus *£9.2.6.* • GL58/RD (Diamond fitted Ronette Binofluid Stereophonic Cartridge) *£21.0.0.* Plus *£8.3.10.*

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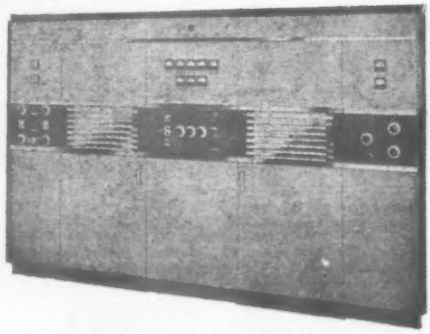
Type ET-4750-X

Frequency range—2 to 22 megacycles.
Keying Speed—up to 250 words per minute.
Power Supply requirements—230 v. 3 phase 50/60 cycles.

Tube complement: Oscillator—807 (1), Doubler (1st) Amplifier—807 (1), Intermediate Power (2nd) Amplifier—813 (4), Power (3rd) Amplifier—889-R (2), Plate Rectifier—872A (6), Auxiliary Rectifier—872A (3), Bias Rectifier—872A (2), Keyer—807 (2).

	Length	Height	Depth
Enclosure	11ft.	7ft. 6ins.	4ft. 1in.
Rectifier Unit	4ft. 2ins.	5ft. 3ins.	3ft. 2ins.
Plate Transformer	2ft. 6½ins.	3ft. 6½ins.	1ft. 9½ins.

Weight (Nett)	
Enclosure (including control, R.F. and Output panels)	3,000 lbs.
Rectifier Unit	1,675 lbs.
Plate Transformer 7,000 volts,	1,250 lbs.



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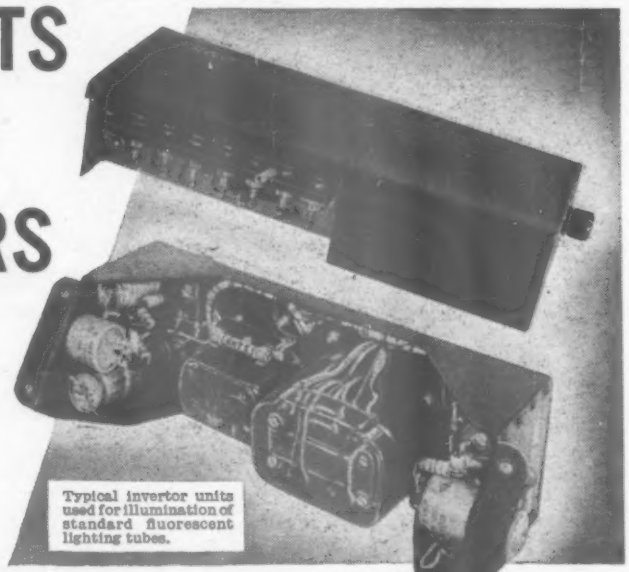

Typical invertor units used for illumination of standard fluorescent lighting tubes.

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Pardon our blushes—

but we do feel very honoured, if not a little embarrassed at times, when we receive such glowing praises from the many satisfied users of Brenell tape recording equipment. To quote but a few—

From a HI FI Fan

. . . in comparison with all other popular makes of recorders on the market, including the very expensive ones, I find that it is by far the best. The quality of reproduction is excellent and, as you claim, it has every worthwhile feature at a price anyone can afford. . . .
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. . . the Recorder has been assembled and we are highly delighted with our preliminary tests and look forward to doing some useful work with it in the education of our children.
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- ★ Frequency compensation at all speeds.
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- ★ Modern style wooden cabinet designed for improved acoustic performance.

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including 1200 ft. tape, empty spool and quality microphone

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4 recording speeds, 3 independant motors.

Permits use of 8½ reels. Price including 1200 ft. of tape	64 Gns.
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Tape deck with provision for extra heads	28 gns.
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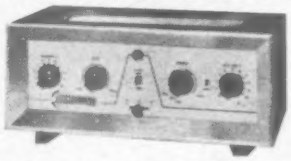

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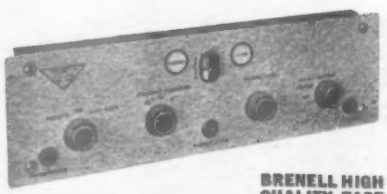

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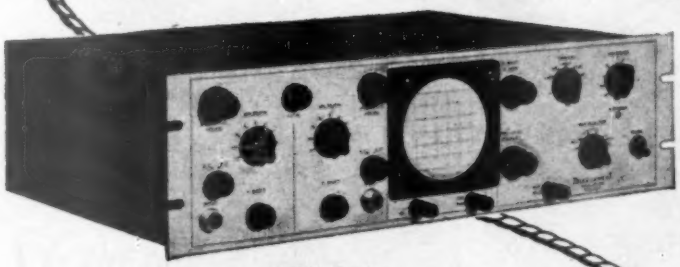

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* WIDE RANGE TIME BASE
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C.R.T.
S31R 3in. 3WP1
D31R 3½in. double gun.

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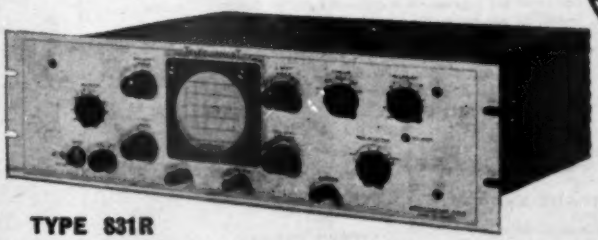

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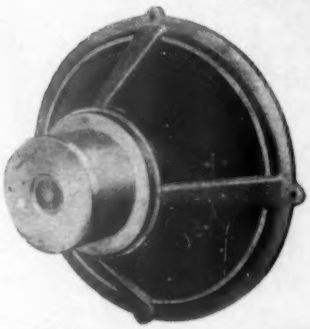

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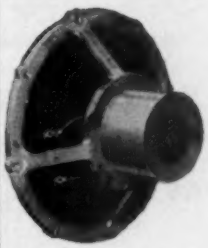

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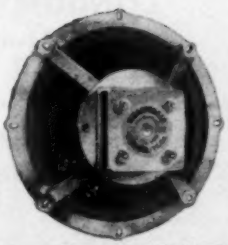

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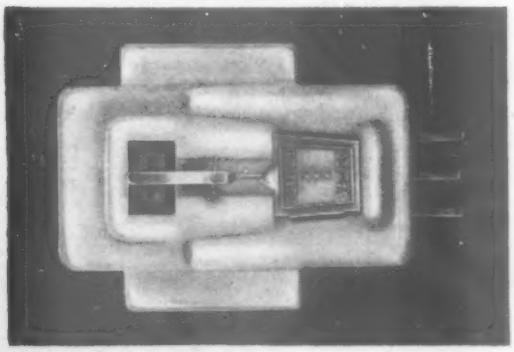

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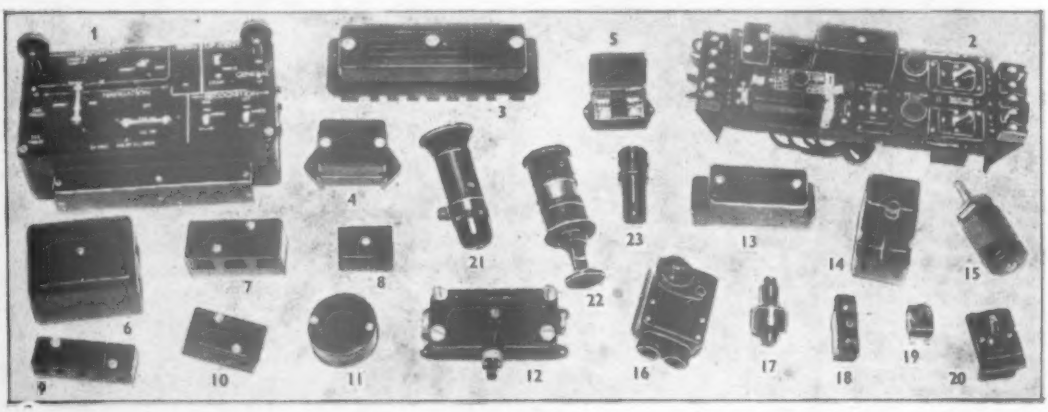

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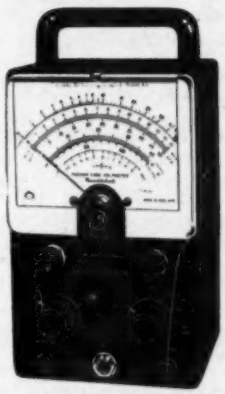

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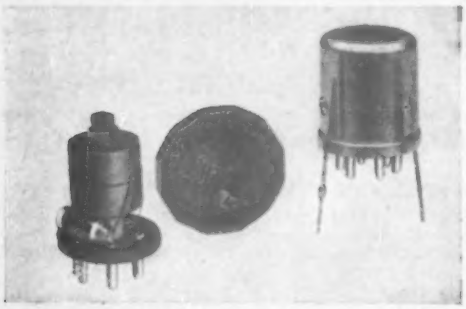

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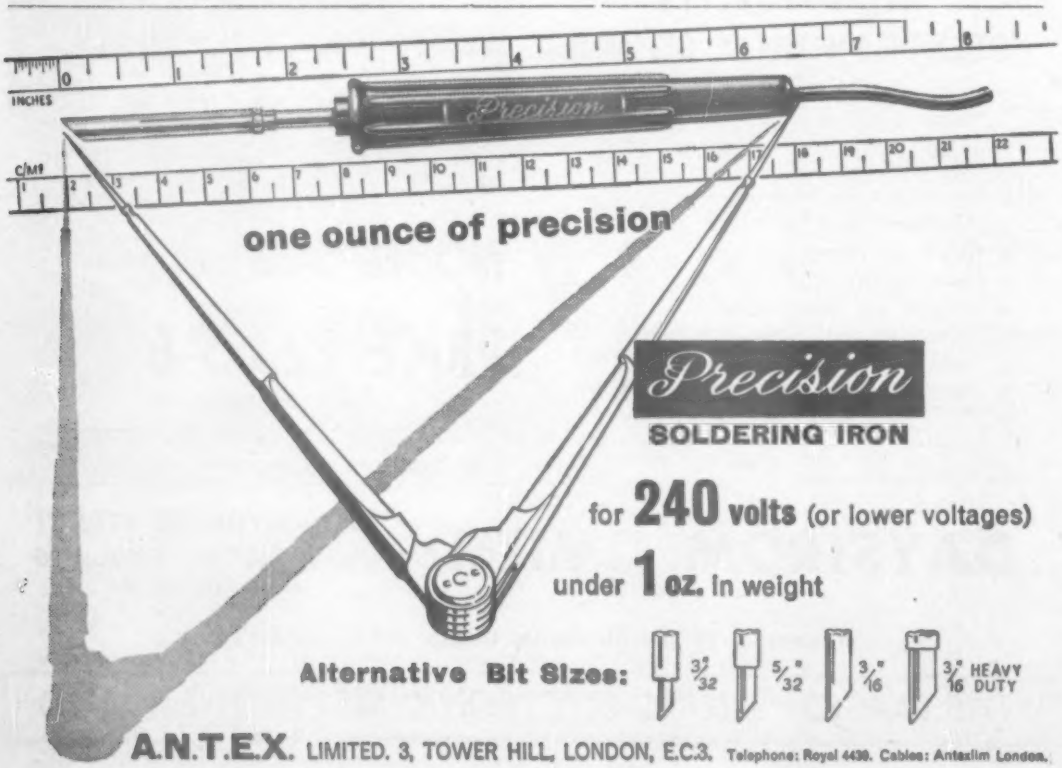

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RUMBLE FILTER. 12 d.b. per octave below 50 c.p.s.

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MAXIMUM POWER OUTPUT. In excess of 33 watts

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NEGATIVE FEEDBACK. Total 28 d.b.

SENSITIVITY. Input (1) 20 millivolts for rated output. Input (2) 200 millivolts for rated output.

HARMONIC DISTORTION. 0.05 ± at 10 watts. 0.1 ± at 20 watts.

OUTPUT SOCKETS. Provide matchings for 3 ohm and 15 ohm loudspeakers.

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VALVES. B.V.A. EF86, EF86, ECC83, EL34, EL34, GZ34.

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WITH INTEGRAL PRE-AMP AND TONE CONTROLS

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Full advantage has been taken of the latest component miniaturization developments to reduce unit size to a minimum. Two high impedance input sockets are provided by microphone and gram., etc. Each input has its associated vol. control. B.V.A. valves are employed, ECC83, ECC83, EL84, EL84, EZ81.

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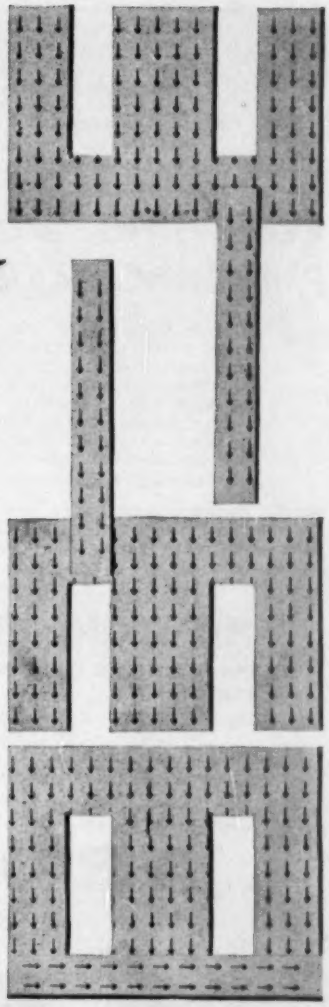

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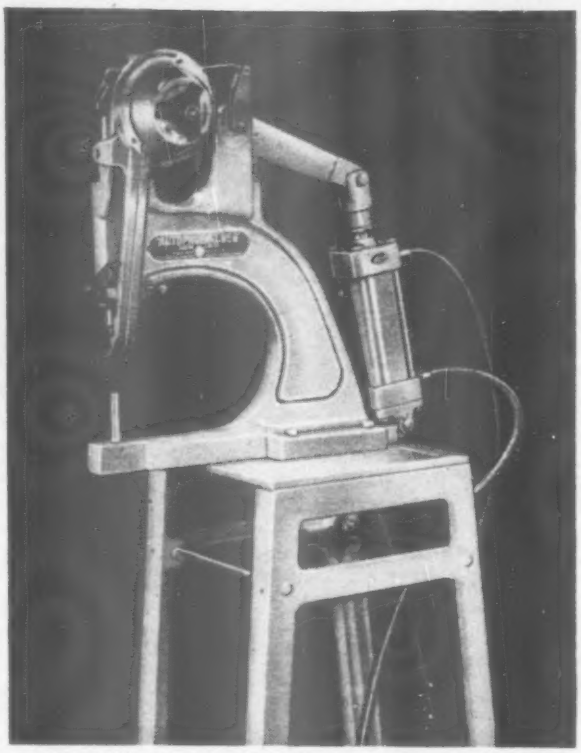

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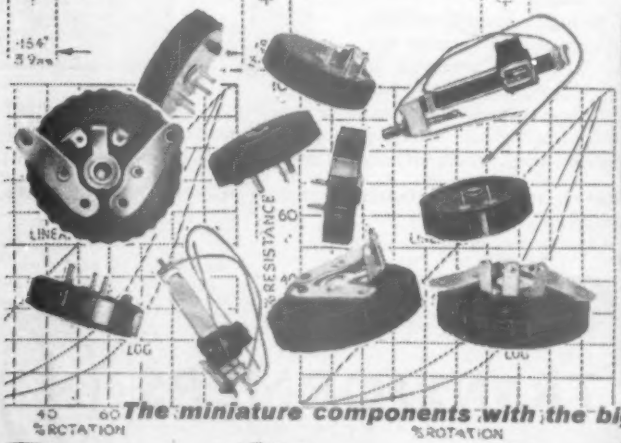

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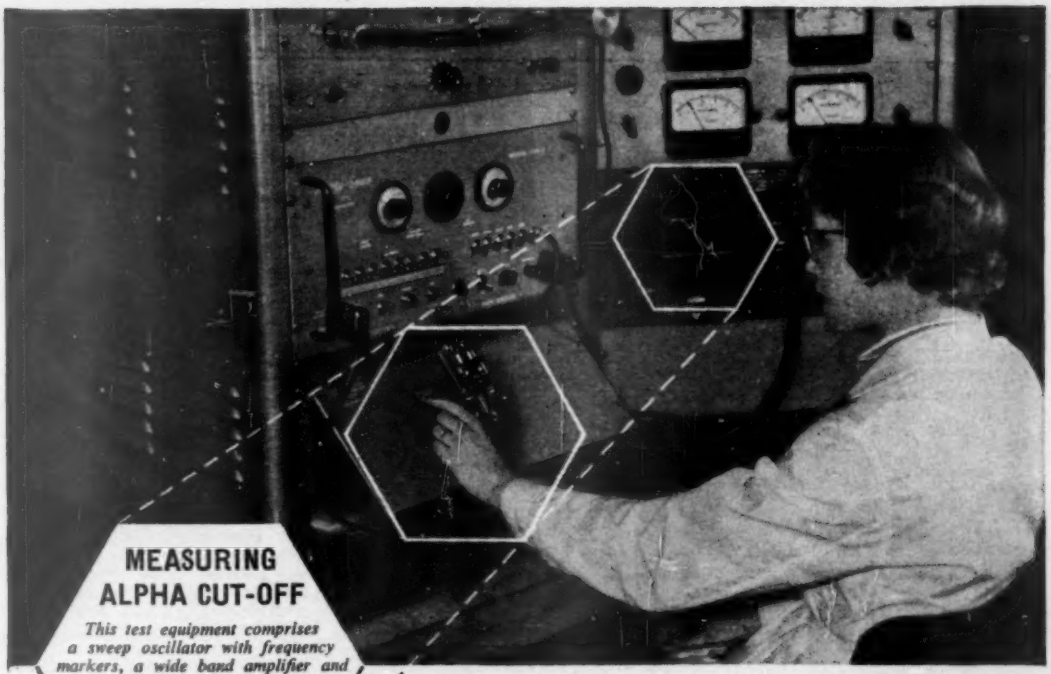

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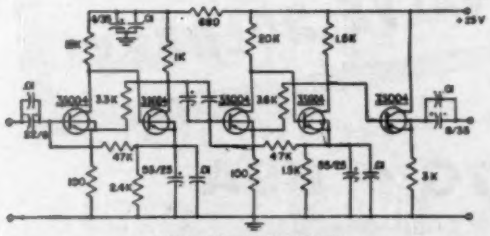
Collector Breakdown voltage	30 volts
Collector current	10 mA

SPECIFICATION

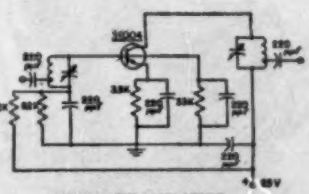
Type No.	*Power Gain*
3S002 (3N34)	16 db (min) at 30 Mc/s.
3S004 (3N35)	18 db (min) at 70 Mc/s.

TWO CIRCUIT EXAMPLES



10 Mc/s VIDEO AMPLIFIER

Measured Power Gain, 53 db. Bandwidth 10 Mc/s. Load Used, 470 Ohms.



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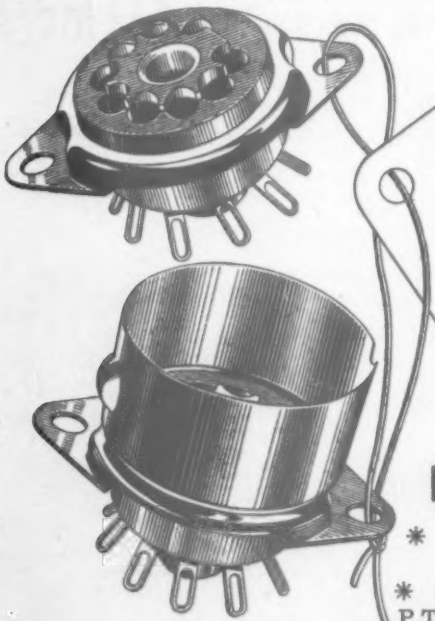

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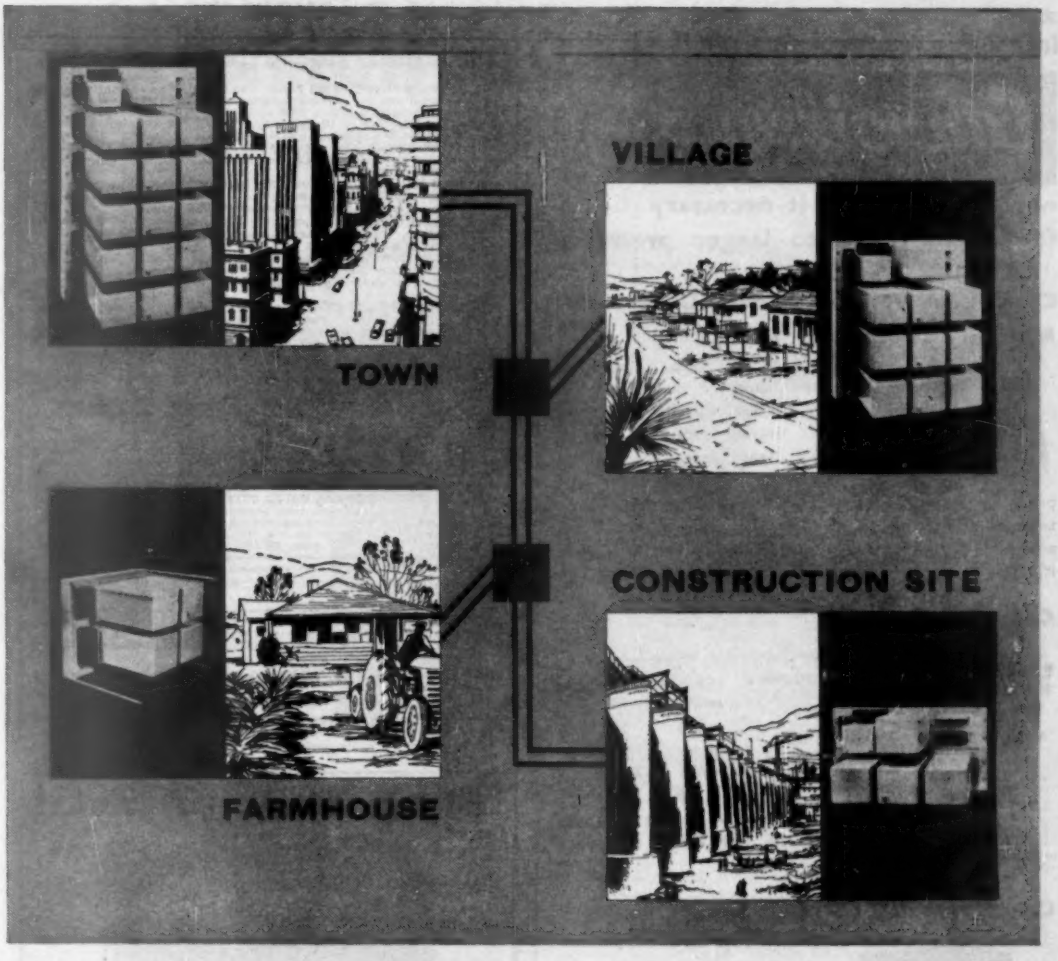

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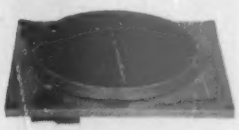

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MINIATURE SERIES WOUND MOTORS. 200/260 v. A.C./D.C. Approx. 1/75th H.P. at 3,000 r.p.m. Size approx. 3in. by 2in. by 2in. and ideal for projector cooling fans, stirrers, etc. Open type, fitted suppressor. 25/- (carr. 1/9).

MAINS RELAYS (Magnetic Devices). 230 v. A.C. coil, with 2-pole change-over 4 amp. switching. Brand new, compact units, approx. 2½in. by 1½in. by 1in. Limited supply at 22/6 each (carr. 1/-).

AIR THERMOSTATS (Kieff-Pullin). Adjustable range 30/90 deg. F. Switching capacity up to 15 amps. A.C. In smart ivorine housing 4½ × 2 × 2in. Easily installed —instructions with each. Right for greenhouses, rooms, labs., etc. 45/6 (carr. 2/-).

SYNCHRONOUS TIME SWITCHES (Sangamo) for accurate pre-set switching operations on 200/250 v. 50 c. A.C. mains. Providing up to 3 on-off operations per 24 hours, with day-omitting device (use optional). Capacity 20 amps. Apart from industrial uses these are eminently suitable for tape recorders, radio, immersion heaters, fires, etc. Compactly housed 4in. dia., 3½in. deep. With full instructions, 85/8/6 (carr. 2/-).

OPERATION COUNTERS (mechanical). Brand new units, with continuous rotary action, counting up to 6,000. One rev. per digit, with 1/10th indicator, will also count motor speeds. Counting forwards and backwards—suitable for tape recorder and film work. Size 3½in. × 1½in. square. Very limited quantity, 39/6 (despatch 1/6).

EXTRACTOR FANS. Very well made units at much lower than normal price. 200/250 v. A.C., induction motor, silent running, no interference. With mounting frame and back grille, ready for easy installation. With 8in. impeller, 200 cu. ft./min., £5/5/-. 10in. impeller, 340 cu. ft./min., £5/12/6. Also new minor model with 6in. impeller, 75 cu. ft./min., £4/12/6 (despatch of any one 5/-).

COMPLETE SEWING MACHINE MOTOR OUTFITS. Definitely no better job at any price. We have large sales from recommendations. 200/260 v. A.C./D.C., fitted latest radio/T.V. suppressors, including motor with fixing bracket, foot control and switch, needle light with switch, belt, etc., and instructions for easy fitting to ANY machine. The complete outfit, 26/15/- (despatch 2/9).

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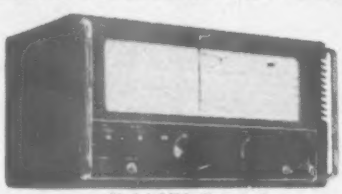

Model 840A illustrated

Cash Prices and Statutory Terms

Model	Cash Price	Deposit	8 Monthly Payments of
820	£31 18 0	£3 14 6	£3 14 6
870	£34 16 0	£4 1 4	£4 1 4
840A	£55 0 0	£6 8 4	£6 8 4
888A	£110 0 0	£12 16 8	£12 16 8
680X	£120 0 0	£14 0 0	£14 0 0

Cash price if paid in 6 months by Bankers' order.
Carriage paid per passenger train.

Model 840A is for A.C. or D.C. 110/250 v.; 750 and 680X 110/240 v. A.C. These sets are the choice of the discerning professional and amateur users. Descriptive literature gladly forwarded.

Latest EDDYSTONE Component Catalogue 1/-.

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The Eddystone Specialists

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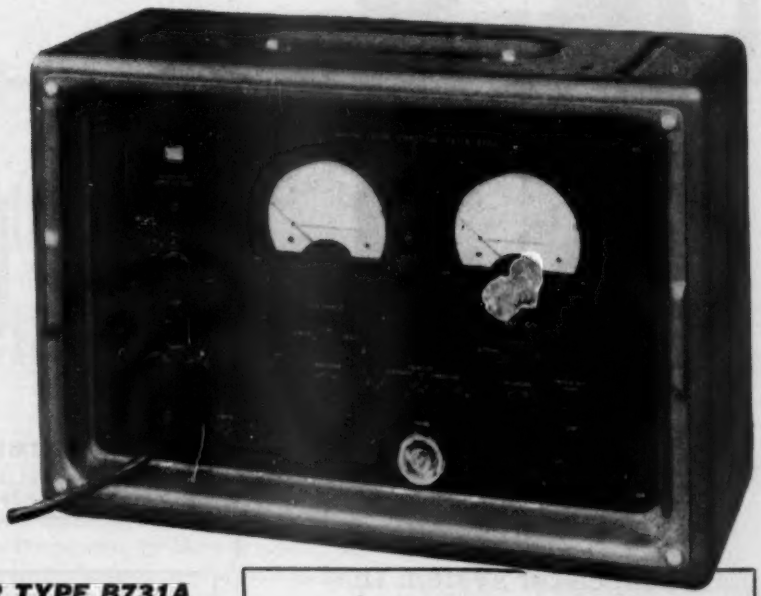
Vibration Measurement

50 micro-inches to 0.5 inch

- **Non-Contacting Probes**
- **No Resetting Problems**
- **Linear Scale**



VIBRATION METER TYPE B731A

Probe cable length is unimportant and vibration measurement independent of probe-to-structure spacing. Frequency coverage is 1 c/s – 10 kc/s and the accuracy is unaffected by magnetic fields. Eccentricity and vibration of rotating machinery can be measured simultaneously and facilities are provided for connexion of recording, alarm, or servo-control systems.

For further information write or telephone

SPECIFICATION

Mains operated, 110/230v, 40-60 c/s.

RANGES: 0-0.001 in (Probe A)
0-0.01 in (Probe C)
0-0.1 in (Probe E)
0-0.5 in (Probe F)
Facility is included on the vibration channel to increase the meter sensitivity by a factor of 5.

ACCURACY: 2 per cent of full-scale deflection at 1 kc/s. Better than 5 per cent at 5 c/s and 10 kc/s.

DISCRIMINATION: Better than 0.5 per cent.

These instruments and others will be on view at the Physical Societies' Exhibition, Wayne Kerr, Stand No. 12.

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GEC presence unit

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★ *Television*
★ *Electronic Devices*
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★ Operates the latest Hi-Fi sound reproducing equipment from DC Mains or Ships' DC supply

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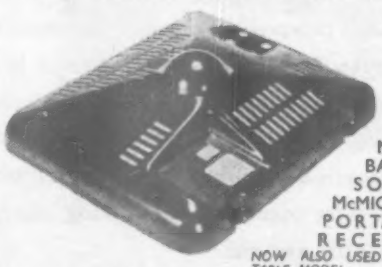
HIGH MECHANICAL STRENGTH at LOW COST ?



MOULDED BACK FOR SOBELL & McMICHAEL 17" PORTABLE TV RECEIVERS.
NOW ALSO USED IN SOBELL TABLE MODEL.

Size of product often precludes the use of a moulding but FIBRE FORM can be moulded in any size.

FIBRE FORM is a new material based on the combination of strong cellulose fibre with synthetic resins. There are other reinforced plastics but FIBRE FORM mouldings are not only LIGHTER and STRONGER, they are CHEAPER.

Leading manufacturers use FIBRE FORM for TV portable cabinets, portable radios, TV masks, TV cabinet backs (right up to 21in console model), radiogram backs, etc., etc. The illustration shows a moulded back manufactured for Radio & Allied Industries Ltd., its strength, dimensional stability and good appearance make this back a vital component of the cabinet design.

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a new range of

SIMET

Silicon Rectifiers...

The SIMET 'G' series of silicon rectifiers will shortly be in production by Plessey. The new rectifiers are based on the designs and manufacturing techniques of the General Instruments Corporation, U.S.A., who produce one of the most comprehensive ranges of medium-power rectifiers, including a complete coverage of all military types.

Plessey manufacturing resources, allied to the established General Instruments design, will ensure a component which is virtually indestructible and capable of long-term and stable operation at temperatures up to 150°C.

AVAILABILITY

Rectifiers for operation in the range 100–1,000 peak inverse volts and carrying a current of 400–750 mA half-wave, 0.8–1.5 amps full-wave or 1.1–2.1 amps in 3-phase full-wave circuits are available in sample quantities now, and in production quantities shortly. Other types will follow the establishment of this medium-power range.

WRITE FOR LITERATURE NOW!

Engineers and senior executives are invited to write for descriptive technical literature.

The new rectifiers will replace the "A" series which have been successfully used in a number of equipments, and will be interchangeable in all respects.

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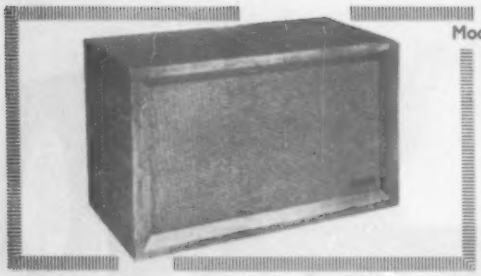


Model **IB3**

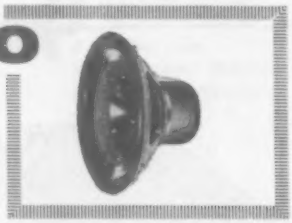
Measures only 24" x 12½" x 14½" high, yet contains a full size 25-watt 3-way High Fidelity Loudspeaker System. Specification and performance outclass most systems three times its size.

Frequency range: 35 c/s—16,000 c/s. **Bass:** (35 c/s to 950 c/s) 12" unique triple suspension, pneumatic air control. ***23 lb. magnet system.***

Mid-range: (950 c/s—5 Kc/s) Pressure driven horn loaded unit.

High Frequency: (5 Kc/s—16 Kc/s) Pressure driven horn loaded unit. Separate external L-pad controls for mid-range and high frequency units. Multiple crossover network. Walnut veneered, hard wax polished enclosure.

Axiom **300**



The most advanced twin radiator 12" high fidelity loudspeaker produced. Provides smoother and more extended response than previously achieved by this type of unit.

Frequency response 30—16,000 c/s. **Power handling capacity** 15 watts. Enclosure volume required, 7,800 cubic inches, with Acoustic Resistance Unit loading. (ARU. 172)

STEREOPHONIC SOUND Two IB3 reproducers are ideal for use with the best stereophonic equipment, and form a very compact system. Two AXIOM 300 units, properly housed, will also provide outstanding performance, but with greater space requirements.

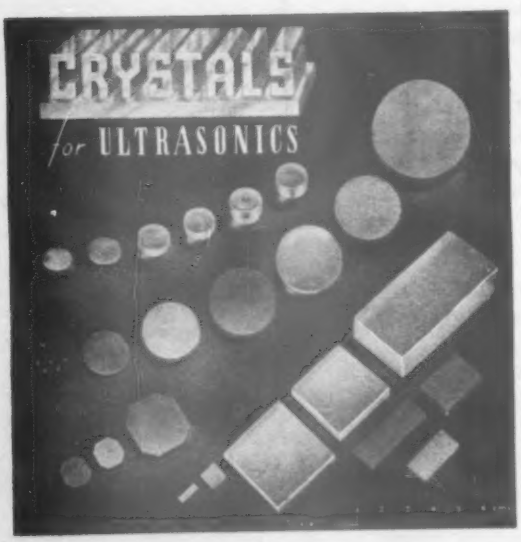
GOODMANS

GOODMANS INDUSTRIES, LIMITED
AXIOM WORKS, WEMBLEY, MIDDLESEX

Goodmans High Fidelity Loudspeaker Manual, ***which contains full information on Goodmans High Fidelity products, free on request.***

...Europe's largest Manufacturers and the World's largest Exporters of High Fidelity Loudspeakers

WEMbley 1200 (8 lines) *Grams: Goodaxiom, Wembley, England*



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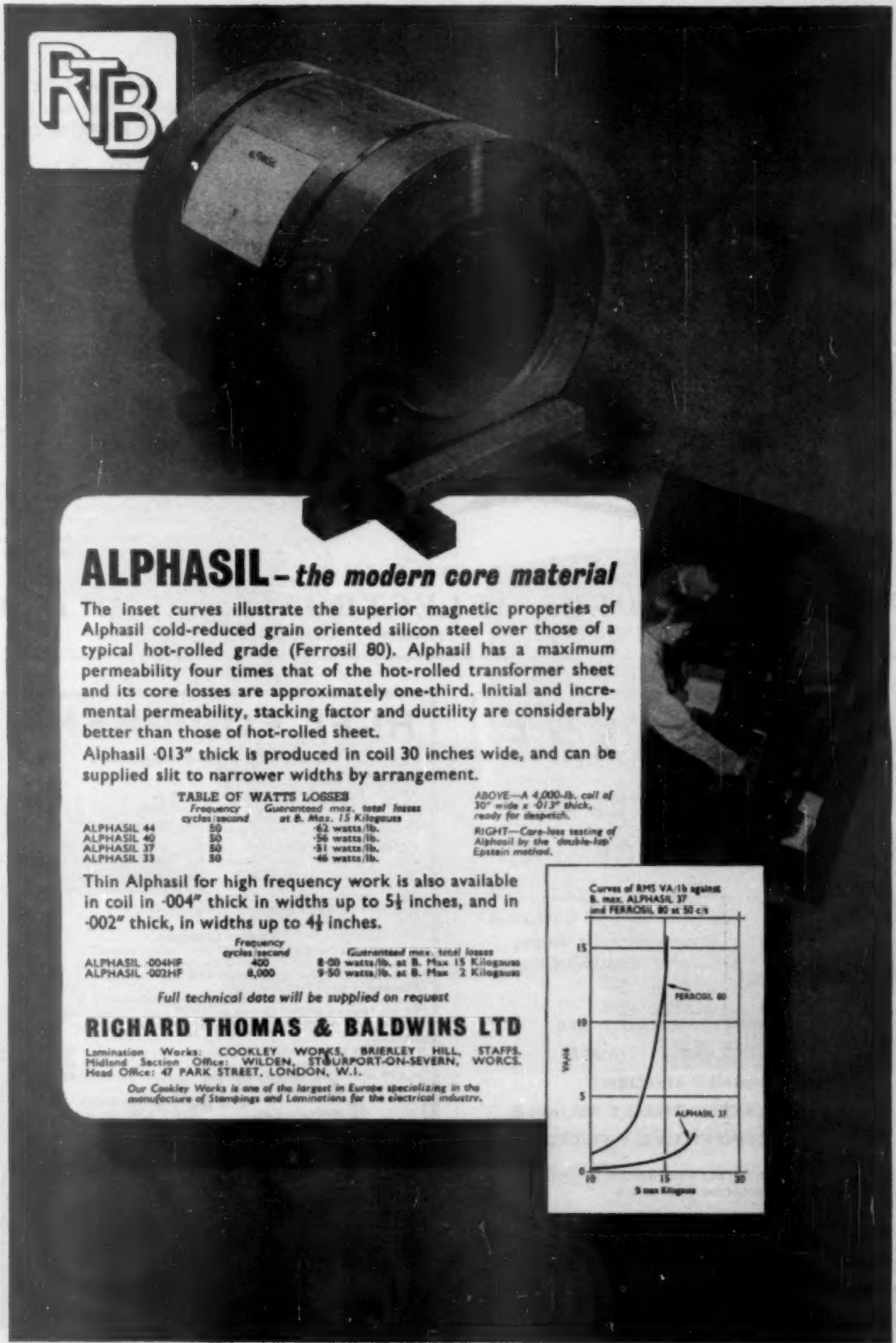

RTB

ALPHASIL – *the modern core material*

The inset curves illustrate the superior magnetic properties of Alphasil cold-reduced grain oriented silicon steel over those of a typical hot-rolled grade (Ferrosil 80). Alphasil has a maximum permeability four times that of the hot-rolled transformer sheet and its core losses are approximately one-third. Initial and incremental permeability, stacking factor and ductility are considerably better than those of hot-rolled sheet.

Alphasil ·013" thick is produced in coil 30 inches wide, and can be supplied slit to narrower widths by arrangement.

TABLE OF WATTS LOSSES

	Frequency cycles/second	Guaranteed max. total losses at B. Max. 15 Kilogauss
ALPHASIL 44	50	·62 watts/lb.
ALPHASIL 40	50	·56 watts/lb.
ALPHASIL 37	50	·51 watts/lb.
ALPHASIL 33	50	·46 watts/lb.

ABOVE—A 4,000-lb. coil of 30" wide x ·013" thick, ready for despatch.

RIGHT—Core-loss testing of Alphasil by the "double-lap" Epstein method.

Thin Alphasil for high frequency work is also available in coil in ·004" thick in widths up to 5½ inches, and in ·002" thick, in widths up to 4½ inches.

	Frequency cycles/second	Guaranteed max. total losses
ALPHASIL ·004HF	400	8·00 watts/lb. at B. Max 15 Kilogauss
ALPHASIL ·002HF	8,000	9·50 watts/lb. at B. Max 2 Kilogauss

Full technical data will be supplied on request

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Remember—Sonocolor is the only complete range of tape there is—standard, long play, double long play, and, for home movie enthusiasts, the new synchro-cine tape.

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HI-FI EQUIPMENT

(CABINETS See page 163)

STEREO RADIO CHASSIS
AM/FM Stereo Radio on one chassis (as illustrated) 8 valve and 2 separate 4-watt output with individual volume control. **27 gns.**

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Dulci SP44 Stereo power amplifier two 4-watt outputs **12 gns.**
Control units available for above
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AF 105 10-valve AM/FM 10-watt push-pull	£37 0 0
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These two compact, portable units together provide full testing facilities for f.m. and a.m. mobile radio telephone sets. The range of tests which can be made is extremely comprehensive and for receivers includes sensitivity, bandwidth, signal-to-noise ratio, image rejection, discriminator symmetry, and a.f. power output. For transmitters, p.a. tuning, r.f. power output, and deviation can all be checked. If you would like further details of these versatile instruments, please write for Leaflets G138.

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TC 138

MAGNAFON *proudly present the*

COURIER STEREOPHONIC

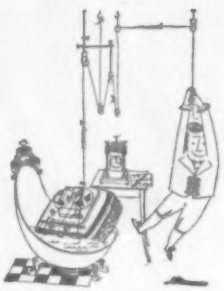
Tape Recorder

Complete with matching Amplifier/Speaker Extension Unit

THE COURIER STEREOPHONIC has all the recording facilities of the Courier Monaural. By the addition of stacked stereophonic heads and an extra amplified output from the second track it will replay pre-recorded stereophonic tapes. The extension unit is 6in. deep and acts as a lid; it contains two matching speakers and matching amplifier. Volume and tone controls are ganged and give matching performance on both units.

PRICE 73 guineas

(Including microphone, tape and spare spool)



Every MAGNAFON instrument is soak-tested for complete reliability.

A tape recorder is a highly complex machine with a great many parts that can go wrong. Experience has taught us that only intensive checking plus soak-testing will locate, as far as is humanly possible, any faults. No Magnafon recorder leaves our factory unless it has been soak-tested for 8 hours or more. This enables us to give a 12 months' guarantee on every Magnafon tape recorder.

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Don't let *hiss-s-s* spoil your recordings

The recording head of any Tape Recorder tends to become magnetised in use. Small at first but gradually building up, this residual magnetism can seriously affect the quality of your recordings by progressively increasing the hiss level. It can also impart a noisy background—which can never be removed—to any pre-recorded Tape *at the first time of playing.* Fortunately residual magnetism can be instantly removed with the Ferrograph De-fluxer. Get one to-day and, if you use it from time to time, you'll always enjoy tape recordings with a background as silent as the night.

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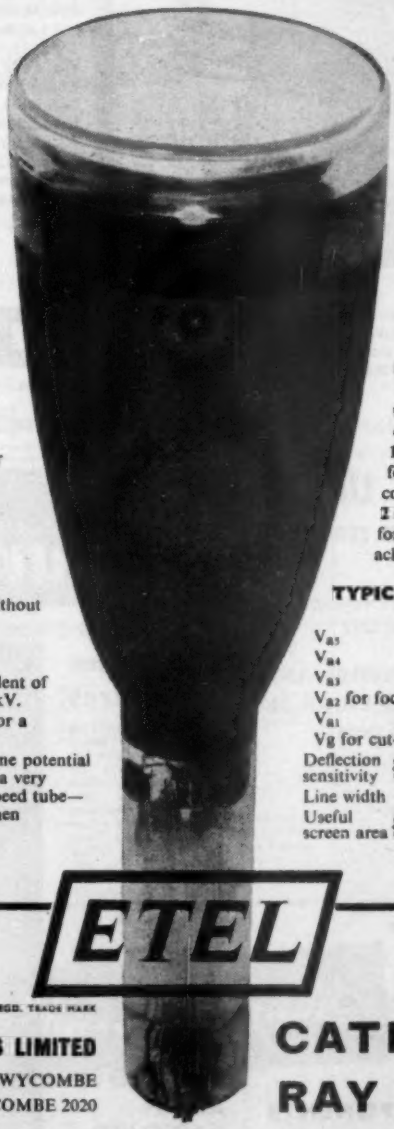
THE FIVE-INCH instrument tube 5CLP1 has a deflection sensitivity of 1.7V/cm with a useful Y scan of 6 cm. A special system of shielding the post-deflection field from the deflection plates in this tube allows p.d.a. ratios as high as 15 to 1 to be used without pattern distortion. The extraordinary deflection sensitivity achieved with such high p.d.a. ratios profoundly affects oscillograph design. Bandwidths can be increased, amplifiers simplified and power supply requirements reduced. Write to the address below for full details of 'Etel' Instrument Tube type 5CLP1.



* P.d.a. ratios of 15 : 1 possible without pattern distortion.
* Sensitivity 1.7V/cm with useful Y scan of 6 cm.
* Sensitivity substantially independent of final p.d.a. voltages from 10 to 15 kV.
* High resolution—only 200 mV for a deflection of one spot-width.
* Versatility—by simply altering one potential the 5CLP1 may be converted from a very sensitive tube to a higher writing speed tube—pulses may be first examined and then a single shot photograph taken.

ABRIDGED DATA

This is tentative. Final data is being prepared.
5-inch flat faced
precision oscillograph tube 5CLP1.

CAPACITANCES

X_1 to X_2 ... 2.5 pF
Y_1 to Y_2 ... 2.0 pF
One X plate to all other electrodes less other X plate 4.0 pF
One Y plate to all other electrodes less other Y plate 2.0 pF

COMPARE CONDITIONS SHOWN IN DATA

1 and 2
to see how deflection sensitivity is maintained over range of V_{a4} and V_{a5}.
1 and 2 with 3
for an illustration of a slightly lower sensitivity condition giving higher brightness.
2 and 4
for the reduction required in V_{a4} potential to achieve higher writing speeds.

TYPICAL OPERATING CONDITIONS

	1.	2.	3.	4.
V_{a5}	10kV	15kV	15kV	15kV
V_{a4}	10kV	15kV	15kV	3kV
V_{a3}	1kV	1kV	1.5kV	1kV
V_{a2} for focus	250V	250V	375V	250V
V_{a1}	1kV	1kV	1.5kV	1kV
Vg for cut-off	-60V	-60V	-90V	-60V
Deflection sensitivity y	1.7V/cm	1.7V/cm	2.5V/cm	2.5V/cm
Deflection sensitivity x	7V/cm	7V/cm	11V/cm	11V/cm
Line width	1mm	1mm	<1mm	<1mm
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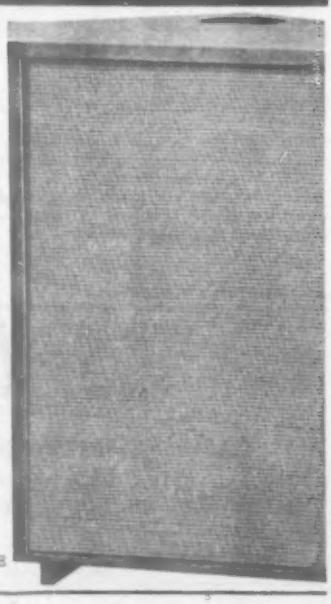

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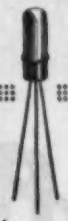

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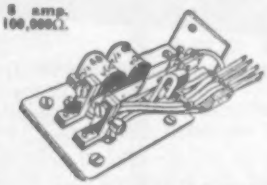

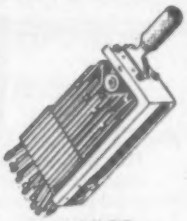

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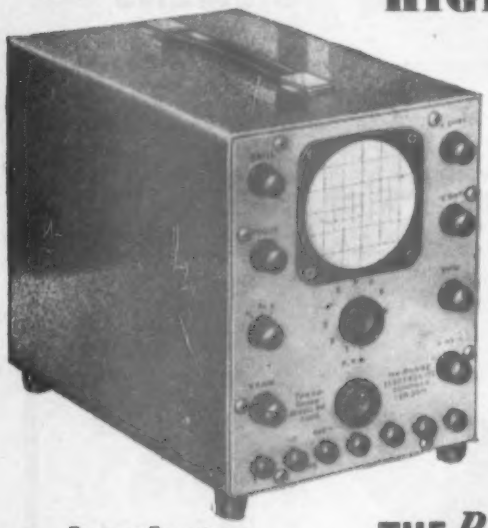

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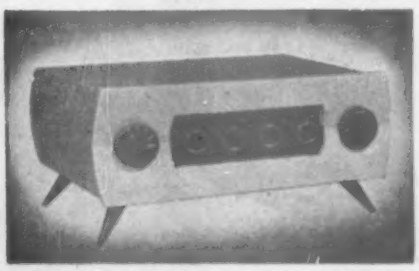

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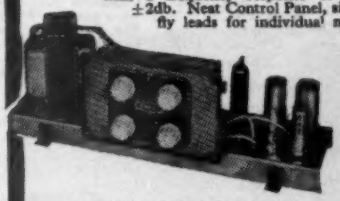

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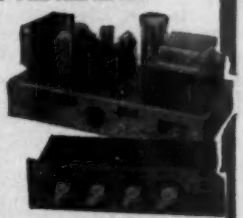

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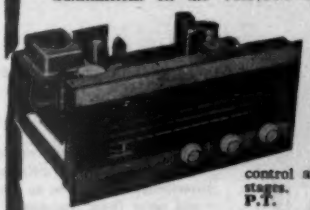

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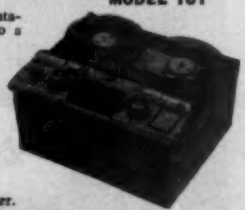

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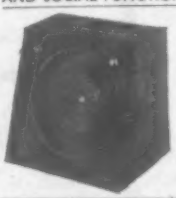

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Case size as above. Complete with transistors, batteries and 2½in loudspeaker, drilled case, 69/6, p.p. 2/6.

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Parts price list, wiring diagrams and circuits 2/6 set of four. Push-pull Four data 1/9. Foreign orders postage extra.

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We describe here a few of the equipments available, complete details of which will be gladly supplied on request.

SA.20. An inexpensive portable instrument which operates as a Counter/Timer and Frequency Meter. 4 decade illuminated presentation covering range 10-100,000 c.p.s. Accuracy of ± 1 count ± 0.005%, five seconds display time, 1 second gate with manual control. Auto and Manual reset, self-checking. A versatile and popular instrument.

SA.21A/B. Measure frequencies from 10 c/s to 1 Mc/s Sine Wave and Pulse. The SA.21B has additional features for time interval measurement in the range 3μ sec to 1,000 secs. Accuracy of ± 1 count and stability of 1 part in 10^8 with temperature controlled crystal. Six decade illuminated presentation. 0.1 to 10 secs. sampling time and variable display time. Self-checking.

SA.28A/B. Comprises SA.21A/B and SA.33 Convertor Unit. Range—10 c/s to 30 Mc/s.

RA.49. Droitwich Receiver. For use in cases when extreme accuracy is required. Tuned to Droitwich transmission with its known high accuracy. Also contains its own crystal with stability of 1 part in 10^7 for use when Droitwich transmission is off the air. Used in conjunction with SA.21A/B or SA.28A/B it controls timing period over which measurements are made, producing alternative pulse outputs of 1 Mc/s and 100 kc/s and sine-wave outputs at 1 Mc/s and 100 kc/s.

SA.34. Frequency Converter. Extends upper frequency limit to 60 Mc/s when used in conjunction with SA.21 or SA.28.

In-line Read-out Type SA.67. Repeats measurements indicated by RACAL Counters in a form easily read at considerable distance. Illuminated 6 digit presentation in 1in. high figures. Used with Translator Unit Type SA.65 will operate with most RACAL Counters.

Digital Print-out System Type SA.71. Provides reliable and rapid means of recording permanent printed readings of Counter measurements. Entirely automatic in operation with high printing speed (approx. 60 prints/min.).

Illustrated is an SA.28 Counter/Timer fitted with RA.49 Droitwich Receiver. The whole equipment gives Droitwich accuracy of count over a range of 0-30 Mc/s.

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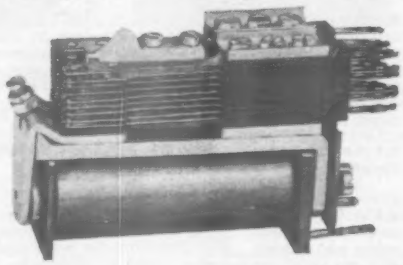

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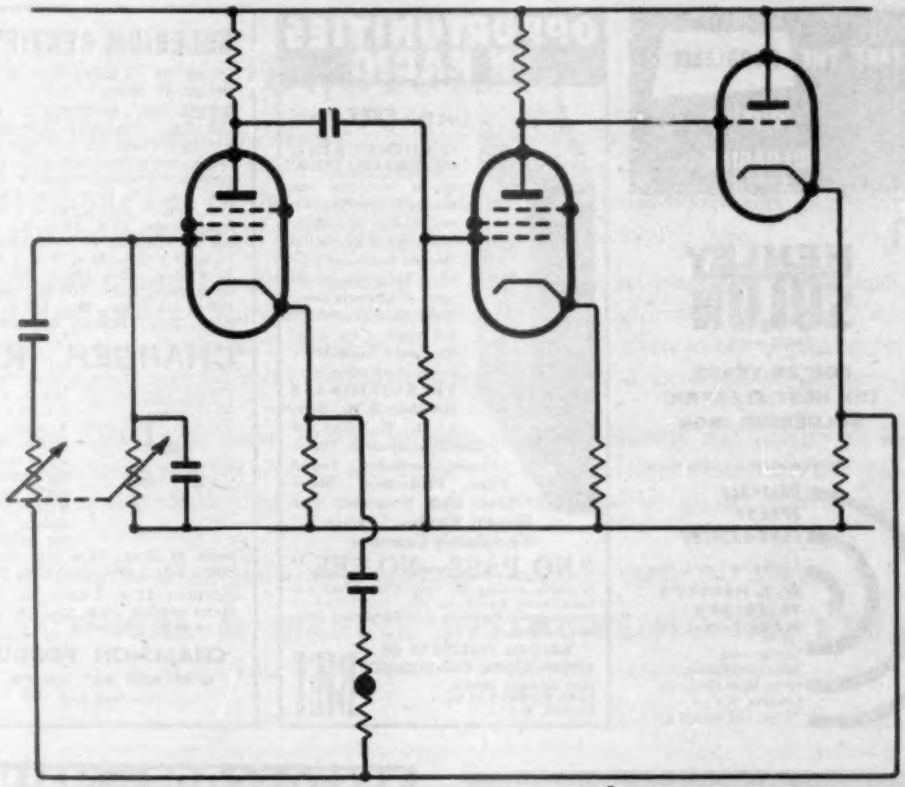

Low-frequency sine-wave generators

The December issue of *Electronic & Radio Engineer* contains a review of modern practice in commercial low-frequency sine-wave generators. The article describes the circuitry currently employed in both the fixed and variable-frequency types of instrument together with an indication of the performance obtainable. The article also describes how different designs have been evolved for different parts of the low-frequency spectrum.

ARTICLES IN THE NOVEMBER ISSUE INCLUDE

Hall Effect in Semiconductor Compounds
Describes the Hall effect in indium-antimonide and indium-arsenide semiconductor compounds and its application to the design of wattmeters, oscillators, flux-density meters and mixer stages.

Currents on Strip Aerials
This article deals with the analysis of the longitudinal distribution of surface currents on strip aerials. A comparison is made between the current distribution for a thin wire and the total current carried by the strip aerial.

ALSO
The unique monthly Abstracts and References feature compiled by the Radio Research Organization of the Department of Scientific and Industrial Research.

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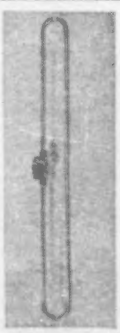

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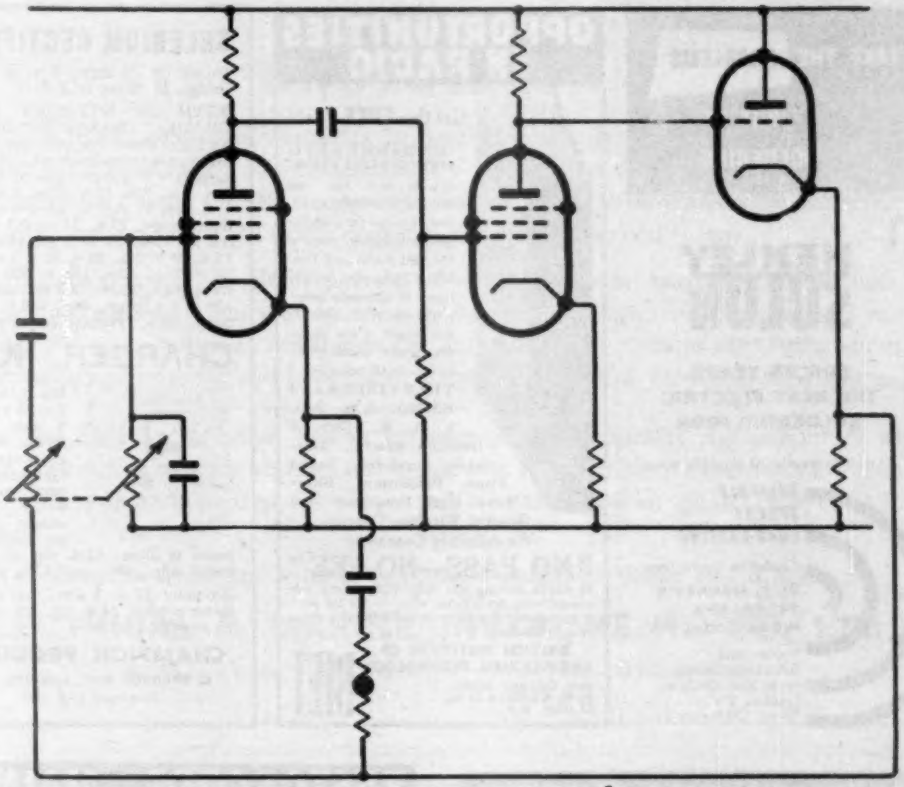

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ARTICLES IN THE NOVEMBER ISSUE INCLUDE

Hall Effect in Semiconductor Compounds
Describes the Hall effect in indium-antimonide and indium-arsenide semiconductor compounds and its application to the design of wattmeters, oscillators, flux-density meters and mixer stages.

Currents on Strip Aerials
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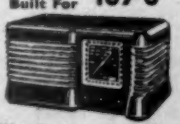

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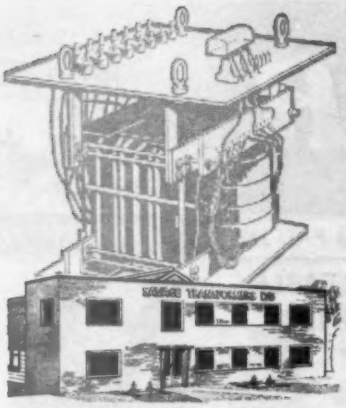

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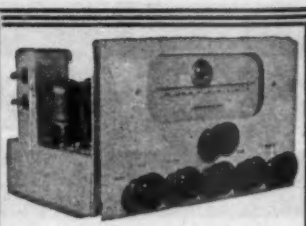

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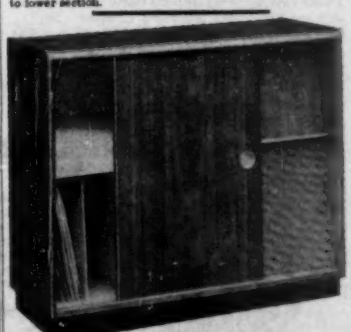

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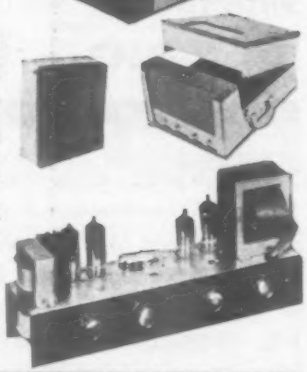

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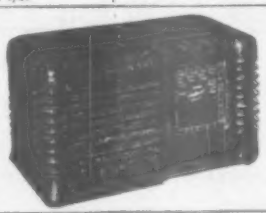

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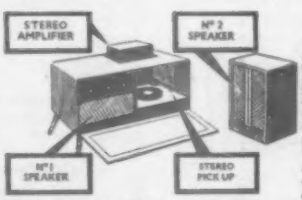

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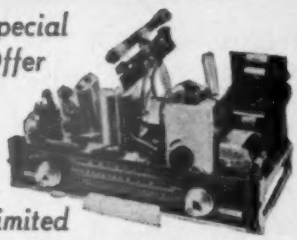

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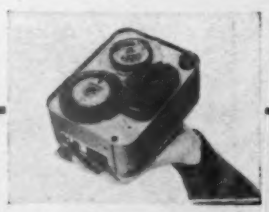

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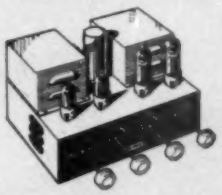

This amplifier uses two ECL86 valves, one 12AX7 valve, one EZ80 valve rectifier. Provision is made for both 3 ohms and 15 ohms speakers. The bass and treble tone controls are ganged and balance is achieved with a separate control. Part may be assembled on a gold hammered finished chassis, with a black perspex dial with gold lettering. Complete set of parts. Price **£6/19/6.** Instruction booklet 1/-. Plus 5/- P. & P.

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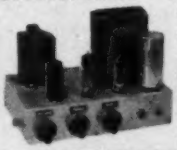

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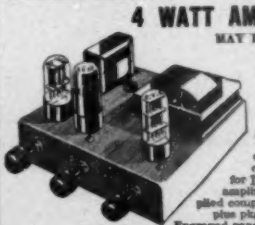

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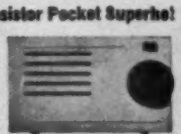

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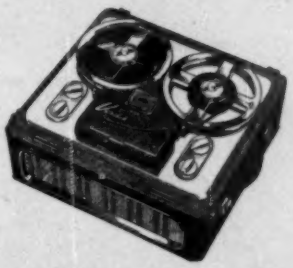

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Wireless World

ELECTRONICS, RADIO, TELEVISION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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JANUARY 1959

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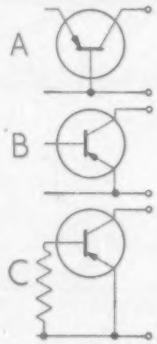
Transistor Breakdown with Inductive Load

The maximum permissible collector voltage of a transistor is usually specified under three sets of conditions:

A: Minimum collector breakdown in grounded base with open circuit emitter;

B: Minimum collector breakdown in grounded emitter with open circuit base;

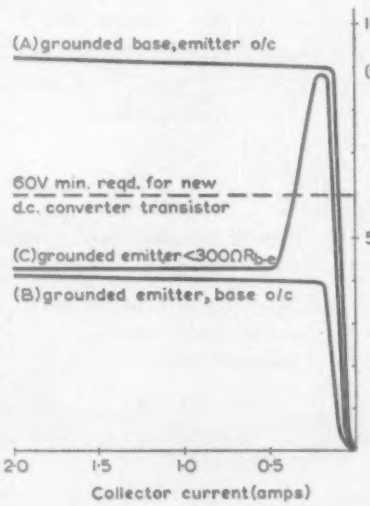
C: A more realistic specification — grounded emitter with base connected to ground through a resistance or impedance of less than some given value.



When transistors are used with resistive collector loads, these cut-off conditions normally represent the position of greatest voltage stress on the device, and they adequately protect the application. As the current increases, the voltage across the transistor goes down, and it is possible to draw all normal load lines and still remain within the transistor requirements—whether expressly stated or implied.

Sometimes, however, an inductive load is used with the transistor in grounded emitter. If the transistor has been fully driven on its base to, say, 2 amps collector current and is then suddenly cut off, current continues to flow in the collector. The voltage across the inductance rises in such a direction that this current is maintained, and the transistor is subjected to a condition of *high voltage and high current* which is never met with in ordinary resistive or theoretical transformer applications.

The graph shows three curves of collector voltage plotted against collector current: Curve 'A' (for condition 'A' above) represents a normal diode breakdown; the transistor softens at, say, 90V.



Curve 'B' (for condition 'B') represents normal avalanche breakdown with the transistor softening at 40V. Curve 'C' shows that with condition 'C' the breakdown voltage at low currents remains nearly that of the collector by itself, as in curve 'A'; but as soon as additional drive current is applied to give higher collector currents, the breakdown voltage rapidly falls, and at about ½ amp is only a little greater than that of curve 'B'.

Thus, if a transistor operated under condition 'C' is passing 2 amps into an inductive load connected to a 24V accumulator, and is suddenly cut off so that the voltage across the transistor rises above its breakdown value of 40V, then the internal dissipation will be 80W. Such a peak dissipation is destructive. At 6 amps (and it is usually peak currents such as this which occur immediately before switch-off) the dissipation is 240W.

TO OBTAIN GOOD LIFE THE TRANSISTOR MUST NOT BE OPERATED EVEN UNDER TRANSIENT CONDITIONS ABOVE THIS REGION OF HIGH CURRENT AND VOLTAGE BREAKDOWN.

Where a power transistor is used in a driven circuit to close a relay or contactor, or to operate servomechanisms, a diode (with or without a series resistance) can be connected across the inductive collector load and will prevent the inductive peak voltage from reaching the transistor. In d.c. converter circuits, however, it is very difficult for the circuit designer to ensure that the peak voltages on the transistor remain low. Designers of d.c. converters and similar inductive circuits should ensure that the switch-off voltage at high current does not exceed the maximum permissible value for the type of transistor which they propose using.

56.34 *Transistors need to have these characteristics specified in their data. Future Mullard data sheets will make limit values on this parameter available to the circuit designer.*

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MVM 414

JANUARY 1959

Vol. 65 No. 1

Wireless World

Quantity and Quality

ACTION to meet this country's present and future needs in scientific and technical manpower has rightly been directed first to what might be termed the logistics of the problem. From this point of view the situation is promising. As Mr. Geoffrey Lloyd, the Minister of Education, has put it*: "The years immediately ahead are of special importance, for there will be coming out of the schools the largest age groups of young people for over thirty years. This is a once-for-all opportunity for remedying our shortages of skilled manpower." The Government is fully alive to its responsibilities and has voted hundreds of millions of pounds for the building of new schools and technical colleges, and the re-vitalization of the old. It has appointed committees and councils to establish more certificates and diplomas and to open up new routes to technical qualification. Due consideration has been given to the possibility of transfer from one course of study to another, so that everyone has the chance of finishing an approved course even though it may be above or below the standard at first thought to be possible.

There seems little doubt that the numbers of students successfully completing the various specified courses will be adequate. The quantities will be there, but what of the quality?

The final arbiters of that quality will be the customers who buy the goods our industry exports; the intermediate judges will be the employers who recruit staff from the colleges or send their apprentices there to acquire theoretical training. Therefore (again quoting the Minister of Education) ". . . the development programme for the technical colleges does not depend only on the efforts of the Government and local authorities; it needs the full backing and support of industry and commerce."

This means that employers must be prepared to make the effort and find the time to collaborate with local technical colleges to narrow the gap which tradition has established between the academic and the workaday worlds, and to find ways and means of developing the qualities of mind which lead to original thought and sound judgment. In particular to decide such questions as how wide the basic training should be; and, if there is also to be specialization, how narrow and how deep? The limitations of human capacity enforce a compromise, but just where the line should be drawn must depend on circumstances and will change with time. In our view the trend must inevitably be towards greater specialization so that at least someone in a team *knows* when the rest have only a vague idea.

Professor E. E. Zepler in his Presidential Address last November to the British Institution of Radio Engineers had this to say:

". . . Such is the expansion of knowledge in almost every field of technology that it is quite a hopeless task to cover fully even one branch of engineering. This is a fact that can no longer be overlooked. Divergence of opinion can only exist as to what should be stressed most, general knowledge or depth of understanding. My own opinion is that it is the latter we should aim at above all things, and we should not be dismayed if, in the process, we find that larger parts of the subject are not adequately covered. There are plenty of books from which the student can acquire a general knowledge, but the ability to think for himself critically and objectively, that is something which he will best learn from lectures and tutorials and this, therefore, should be the foremost aim of inspired teaching. . . . The first duty of a university to a student is to 'teach how to think'. . . . The method of thinking, the fundamental treatment and the mathematical approach are often surprisingly similar in different branches of science, so that mastery of one subject is a large step towards mastery in others."

To those who fear that specialization may lead to narrow-mindedness we cannot do better than quote the words of Lord Adrian, Master of Trinity College and Vice-Chancellor of Cambridge University who said at last year's Annual Dinner of the Institution of Electrical Engineers:

"But personally I have never found that the subject a man takes makes very much difference to his range of interests; it can be as wide or as narrow as you please, whether the man is doing hydrodynamics or Anglo-Saxon. I do not think we can widen interest by force. We can do something by guile. Colleges and universities cannot help allowing all the faculties to mix up out of school hours, and we are glad to let them do it because it means that the chemist may sit next door to the law student in hall and talk to him about poetry. Sometimes they do not talk at all and when they do it may be about rugby or the Bank Rate; but at least they can share their views with people in a different line of work so they will not seem quite so odd when they get out into an industrial concern."

* Ministry of Education Pamphlet "Britain's Future and Technical Education."

Stereophonic Record Pickups

PRINCIPLES OF CURRENT DESIGNS

By F. OAKES*, A.M.I.E.E., A.M.Brit.I.R.E., and D. V. CHARLESWORTH*

ALTHOUGH the principles of two-channel stereophonic sound reproduction have been known for some considerable time, acceptable recordings on disc, and suitable pickup mechanisms to recover stereo information from the disc, have only recently become commercially available. The recovery of stereo information, i.e., the conversion of a combined mechanical signal into two separate electrical signals, can be carried out in a number of different ways, and a variety of pickup mechanisms have been developed, incorporating many ingenious ideas to fulfil this function.

* Ferguson Radio Corporation.

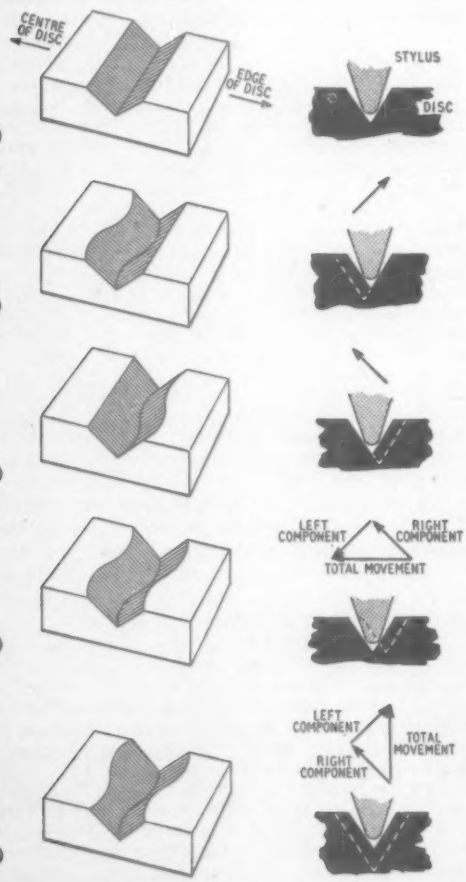


Fig. 1. The 45-45 recording system. (a) No modulation, (b) left-hand channel only modulated, (c) right-hand channel only modulated, (d) both channels modulated in phase and with equal amplitudes, (e) both channels modulated with opposite phases and equal amplitudes.

Basic Principles.—The fundamental problem of two-channel stereophonic reproduction lies in the storage and recovery of two sets of information. Each of the two sets corresponds to one channel of the system. With tape, the solution is comparatively simple. Two separate tracks are simultaneously recorded on the same tape. They are played back simultaneously although otherwise independently. Synchronism is thus ensured and simplicity maintained at the expense of using twice the area of tape as compared with single-channel recording. On disc, matters are more complicated, because the two channels have to be recorded in a single groove.

With single-channel recordings the groove is modulated in one direction only. A lateral cut is used, resulting in a groove of constant depth and width (disregarding second order effects). To store the information content of both channels in a single groove, an additional degree of freedom is required. This can be obtained by the use of vertical as well as horizontal excursions of the cut; in other words, by recording one channel laterally and the other in a hill-and-dale fashion. The pickup stylus will move laterally if information is recorded on the lateral channel only; it will move up and down if information is recorded only on the other channel. The main disadvantage of this method is its asymmetry with respect to the two channels. For instance, the vertical rumble component is usually considerably in excess of the horizontal component. The pickup tracing geometry will also have different effects on the horizontally and vertically modulated channels. To avoid these asymmetries, a different method, called the "45-45 system," has been adopted as standard practice for most two-channel stereo-disc recordings. This system accommodates the two-channel information in a single groove in such a manner that symmetry is preserved with respect to the two channels, the modulations of the groove being at $+45^\circ$ to a vertical tangential plane for one channel and at -45° for the other. The phases are so arranged that with the channels in phase and of equal amplitude a lateral modulation of the groove is obtained, whereas a vertical modulation results from out-of-phase signals. This system is illustrated in Figs. 1 (a) to 1 (e).

The following facts can be observed when studying these illustrations:

(a) When the groove is unmodulated its width (at the record surface) and depth are constant, and the stylus exploring the groove is stationary.

(b) When only the left-hand channel is modu-

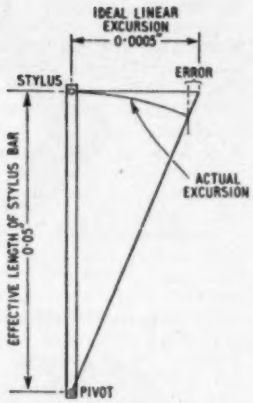


Fig. 2. Errors incurred by non-rectilinear excursions of the stylus. With the dimensions shown the error is less than 0.01% of the excursion.

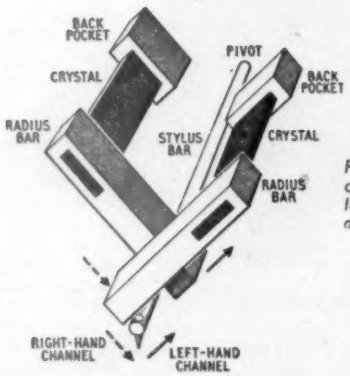


Fig. 3. Mechanical component resolution using separate radius bars.

lated, width and depth of the groove vary and the stylus moves along a line at −45° to the vertical.

(c) When only the right-hand channel is modulated, width and depth of the groove vary, and the stylus moves along a line at +45° to the vertical.

(d) When both channels are modulated in phase and equal amplitude, width and depth of the groove are constant and the stylus moves laterally, exactly as on an ordinary single-channel disc.

(e) When both channels are modulated 180° out of phase and equal amplitude, width and depth of the groove vary, and the stylus moves in a vertical direction.

Normally, combined modulations of both channels are present, and the stylus moves in a plane at right angles and radially disposed with respect to the disc surface; its movement cannot be restricted to a single line as in an ordinary lateral pickup (ignoring pinch-effect).

Thus, it can be seen how the individual information contents of the two channels are combined in a single groove, and transmitted to a single stylus exploring this groove. In order to separate the two sets of audio information, the planar movement of the stylus has to be resolved into two linear components, each corresponding to the appropriate modulation component.

Mechanical Component Resolution.—For accurate mechanical resolution of a two-dimensional movement into two one-dimensional, independent components, a complicated mechanical device comprising a number of precision-made moving members might appear to be necessary. In the case of the stereophonic pickup, however, the small amplitude of the excursions which the stylus has to trace, make it possible to reduce this difficulty. Considering a bar held at one end and carrying a stylus on the other, it can be understood that the stylus will not move in a plane but in a curved surface as a stereo record groove is explored. The excursions, however, are of the order of only 0.001in peak-to-peak or less, and from Fig. 2 it can be seen that to trace an excursion of 0.001in the stylus bar length need only be of the order of 0.05in to render the error between an ideal planar excursion and the actual curved excursion of its movable end negligible.

A simple but effective system for the resolution of stylus-movement into the two stereo components can therefore be based on the principle shown in Fig. 3. Here, the stylus is fixed to one end of a stylus bar which is parallel to a tangent of the record groove at the point of contact and pivots or flexes round its other end. As the groove is explored, the stylus and stylus bar move, moving also the radius bars which are held against the stylus bar by the reaction of the playing weight. If the stylus moves in a −45° direction only, i.e., parallel to the right radius bar, only the left radius bar will move—and vice versa. For a horizontal stylus movement, the two radius bars flex both clockwise or both anti-clockwise simultaneously, for a vertical movement one will move clockwise while the other moves anti-clockwise. In this way, the combined motion of the stylus is resolved into two components corresponding to the two individual channels. The excursions are small compared with the lengths of the radius and stylus bars, they will therefore have an almost exactly linear relationship to the appropriate components of the stylus movement, and the accuracy of resolution will be high.

As the combined mechanical movement is resolved into two appropriate mechanical components, these must in turn be converted into appropriate electrical signals. This can be done by using Rochelle salt crystals. If these are of the so-called "twister" type, they will give a voltage output proportional to the amount of mechanical twist applied. In the mechanism described, one end of such a crystal is embedded in one radius arm of the structure shown in Fig. 3 and one end of a second crystal in the other radius arm. The other end of each crystal

Fig. 4. Garrard stereo pickup with part of one crystal cover removed.

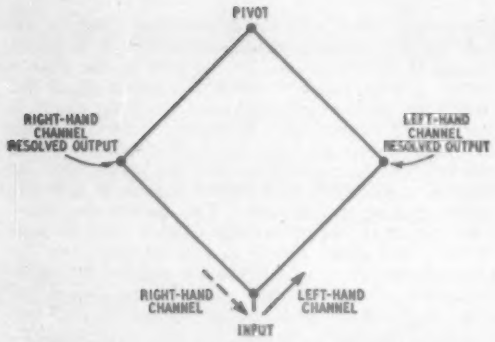


Fig. 5. Diamond structure resolver.

is held rigidly. When the radius arms are flexed, the crystals are twisted, and appropriate electrical signals are generated. This principle provides the basic method for the Garrard pickup, a photograph of which is shown in Fig. 4.

Another method of resolution into two rectilinear components is the diamond structure shown in Fig. 5. This is formed by four rigid members joined together flexibly, and pivoting about one corner. If the corner opposite the pivot is moved in the plane in which the diamond structure lies, the two remaining points will also move, but in such a manner that a $+45°/-45°$ resolution of the initial movement is obtained. This can be seen by imagining the bottom moving point displaced by a small amount in the direction of the arrow drawn as a broken line. Such a movement will cause the bottom right arm to swivel round the right corner leaving the top right arm stationary. The bottom left arm on the other hand will move along its axis and will cause the top left arm to swivel round the top pivot point. In other words, a movement due to modulation in the right-hand channel will cause the top left arm to swivel but will leave the top right arm stationary. For a modulation in the left-hand channel, as shown by the solid line arrow, an analogous process will ensue, with the functions of the left and right sides exchanged. A vertical upward movement of the bottom moving point is seen to cause a clockwise movement of the top left and an anti-clockwise movement of the top right arm. A horizontal or sideways movement will cause both top arms to rotate in similar directions. If amplitudes are small, a composite movement of the bottom moving point will thus be resolved into two linear movements of the elbow points, or into two swivel-movements of the two top arms, so that the resolved movements are linearly proportional to the $+45°$ and $-45°$ components of the initial composite movement.

This is one of the classical methods for mechanical resolution into two components, and several pickups are based upon it. As an example, the arrangement of the Acos pickup is shown in Fig. 6. A photograph of the actual device is shown in Fig. 7. The diamond-shaped resolver is made of a resilient plastic material, and the ends of the piezoelectric crystals are embedded in the upper arms. The notch at the bottom accepts the stylus bar where the movement is transmitted from the stylus to the mechanical resolver. The plastic resolver is distorted by the movement applied at this point, but the excursions are sufficiently small to keep the non-linearities introduced to a negligible magnitude, allowing only the linear components to contribute materially to the resolved output, twisting the two crystals. The electrical outputs are therefore again proportional to the appropriate components of the groove modulation.

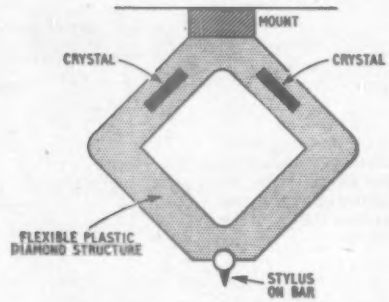


Fig. 6. Acos diamond structure resolver.

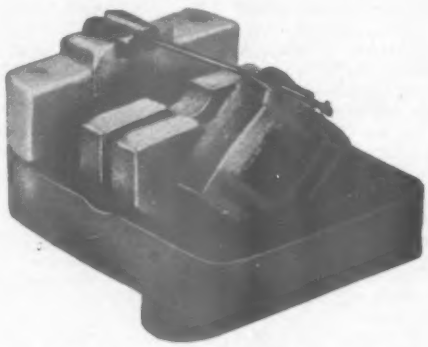


Fig. 7. Acos stereo pickup with cover removed.

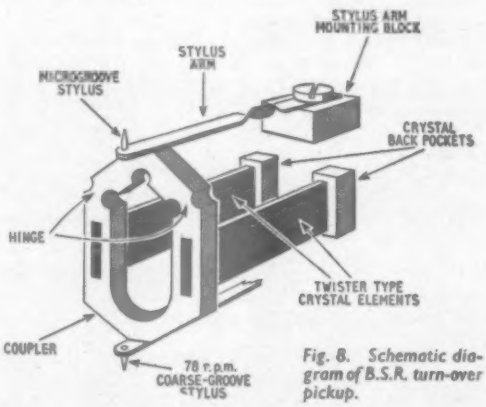


Fig. 8. Schematic diagram of B.S.R. turn-over pickup.

An elaboration of this principle is used by B.S.R. for the design of a turn-over pickup to play 78 r.p.m. single-channel coarse-groove records on one side, and both single-channel and stereophonic microgroove records on the other side. Fig. 8 shows a

schematic diagram of the working parts. In the position shown, the pickup is in the 78 r.p.m. position, and lateral only modulation will twist both crystals simultaneously as the stylus moves from side to side. If the pickup is inverted, it will resolve the stylus movement in a manner very similar to that of the diamond-structure. A photograph of the B.S.R. cartridge is shown in Fig. 9.

The methods described above are basically two-dimensional in that the resolution of a planar movement is carried out within this same plane. An interesting three-dimensional method is shown in Fig. 10. Resolution is carried out in planes at right angles to the original plane of movement. The structure illustrated can be regarded as a corner cut from a cube-shaped box pivoted at the corner point P. If the input point A is moved in a plane parallel to the BPC plane, resolved outputs can be obtained from points B and C. (It must be realised that the excursions of the input point are actually confined to a spherical surface, but for the small excursions under consideration, this can be regarded as equivalent to the tangential plane at the point A). Various kinds of input movements and their resolution are indicated by the various arrows in Fig. 10. For instance, a movement at a $+45°$ slope to the verticals corresponding to the arrow drawn as a solid line and a right-hand channel only modulation, will rock the structure about its PC edge keeping C stationary, but moving B by the same amount at 45° to the B-C axis in a horizontal plane, as the input point A is moved in the vertical plane.

This principle is embodied in the Columbia Broadcasting System (C.B.S.) stereo pickup shown schematically in Fig. 11. The stylus is carried by a bar which is made flexible so that the effective stylus pivot point is not the point at which the stylus bar is clamped (P'), but at P say. Two wing-shaped metal vanes are attached to the bar for transmission of the output forces to piezoelectric crystals. The dotted lines indicate the structure in Fig. 10 from which the functions of the device can be derived. A photograph of the C.B.S. cartridge is shown in Fig. 12.

A similar principle can be used to obtain resolution of the composite stylus movement into appropriate voltage outputs by means of the moving-coil principle. Fig. 13 shows two coils of wire at right angles to each other and attached to a stylus bar going through the line of intersection of the planes in which the two coils are situated. The assembly is placed in a magnetic field parallel to the stylus bar, pivoted at the centre point P, and so oriented that the stylus bar, lying along the Z axis, is parallel

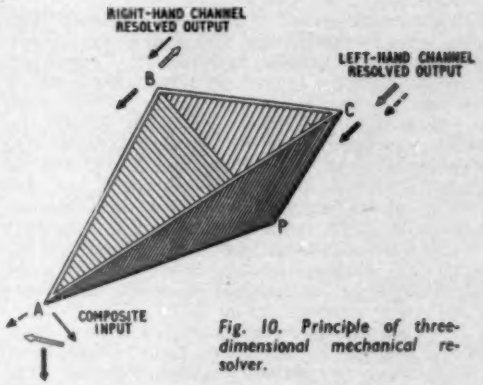


Fig. 10. Principle of three-dimensional mechanical resolver.

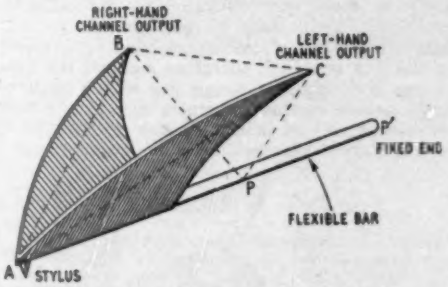


Fig. 11. Schematic drawing of C.B.S. practical three-dimensional resolver.

Fig. 12. C.B.S. stereo cartridge.

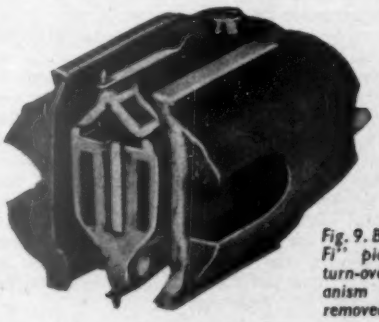


Fig. 9. B.S.R. "Ful-Fi" pickup with turn-over mechanism and front removed.

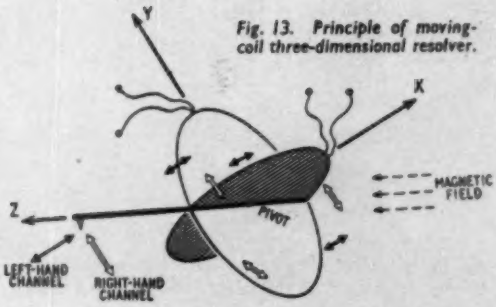


Fig. 13. Principle of moving-coil three-dimensional resolver.

with the record groove at the point of contact. The coils, lying in the ZX and ZY planes, respectively, are at 45° to the vertical, as shown. If, for instance, only the right-hand channel is modulated, the Y coil rotates about the X axis but in its own plane as indicated by the arrows, whilst the X coil also rotates about the X axis, but leaving and re-entering its original plane. Thus, only the X coil will cut lines of magnetic force, and only the X coil will give a voltage output. In this way, the composite movement of the stylus produces an appropriately resolved stereo voltage signal at the output terminals. A schematic drawing of such a moving-coil pickup made by the Fairchild Recording Equipment Corporation is shown in Fig. 14.

A completely different approach has been made in designing the Tannoy "Vari-Twin" stereophonic pickup which is a variable-reluctance device. The principle of operation can be understood from Fig. 15. The stylus bar completes an individual magnetic circuit with each of the four pole pieces. A small movement of the stylus bar in the direction of the flux lines will therefore increase the air gap of one and decrease the air gap of the other magnetic circuit in this particular direction. Such a movement will be at right angles to the flux lines of the two remaining magnetic circuits and will leave their air gaps virtually unchanged. If the windings are so connected that the e.m.f.'s introduced by a movement in the direction of flux for one pair constituting one channel add, then the second-order gap changes due to the movement at right angles will produce e.m.f.'s of opposite sign, so that the errors tend to cancel out. Movement of the stylus bar in the A direction produces e.m.f.'s in coils 1 and 3 with the following polarities:—coil 1: F+, G−; coil 3: F−, G+. Similarly, movement in the B direction produces e.m.f.'s in coils 2 and 4 with the following polarities:—coil 2: F+, G−; coil 4: F−, G+. Thus movement of the stylus bar in the A-direction will result in an output from terminal 3, in the B direction in an output from terminal 1. A composite movement will be resolved and appropriate voltages produced at terminals 1 and 3, terminal 2 being earthed. When playing single-channel fine-groove records, terminal 3 is earthed and the output obtained from terminal 1. A photograph of the Tannoy cartridge is shown in Fig. 16.

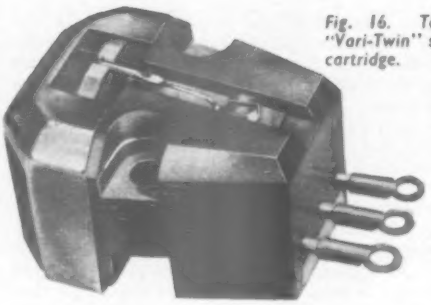


Fig. 16. Tannoy "Vari-Twin" stereo cartridge.

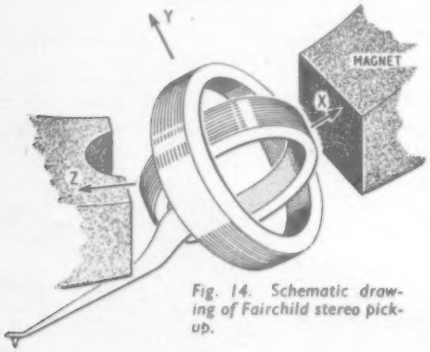


Fig. 14. Schematic drawing of Fairchild stereo pickup.

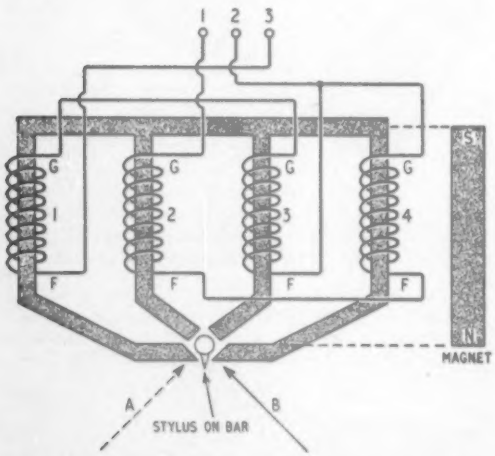


Fig. 15. Principle of Tannoy variable-reluctance stereo pickup.

Apart from fulfilling the function of resolving the mechanical input and converting it into appropriate electrical voltages, the mechanisms discussed above must be of such construction and weight as to be able to track the groove faithfully and without causing damage to the record. This means that the stylus assembly mass must be small, and its compliance must be large. The stylus should be so dimensioned that it rides on the walls of the groove without touching the bottom. Ideally, the stylus should have a tip radius between 0.0005 and 0.0006in, but up to 0.00075in radii are used for compromise styli to play stereo as well as single-channel fine-groove gramophone records. The groove angle is nominally 90° and the bottom of the groove radius about 0.0001in. The modulation is normally so arranged that the right-hand sound channel corresponds to the groove wall which faces the axis of the disc.

The performance which is obtainable with stereophonic records and pickups is not quite up to the standard of the best single-channel records at the present time. But although there is still room for improvement, the results achieved are most encouraging. In spite of the lesser fidelity, a far greater impression of realism is, in our opinion, achieved by the use of stereophonic reproduction, making worth while the effort and ingenuity that has been set to work to bring this new venture in sound reproduction within reach of the general public.

The authors are indebted to the manufacturers of the pickups, the mechanisms of which are described, for their assistance in providing material for the preparation of this article.

JAPAN'S RADIO INDUSTRY

THE recent announcement that Japanese transistor receivers are now permitted to be imported into this country has re-focused attention on the rapidly growing radio and electronics industry in Japan. A five-year plan for the industry, drawn up by the Ministry of International Trade and Industry, envisaged a total production of £195M in 1958 increasing to £446M in 1962.

During the five years over 13M sound receivers are to be manufactured, of which about 50 per cent. will be for export. The value of sound receivers produced during the period is planned to increase from £28M in 1958 to £46M in 1962. Transistor receivers form about 40 per cent. of the overall total. Japan produced 5.5m. transistors in 1957 and it is expected that the 1958 figure will be over 14M, rising by 1962 to some 70M.

There are, at present, something over a million television receivers in use in Japan. The industry's output for 1958 was expected to be just under a million receivers, and during the five-year period just under 7M. The plan provides for an overseas market of over 600,000 television sets during the period. The output of cathode-ray tubes is to go up from £13.5M to £34M. It is interesting to note that of all the figures quoted in the five-year plan only one, for radar, shows no increase, remaining at just under £500,000 for each of the five years.

To foster the export of radio and electronic equipment the Ministry waives the tax on income from exported goods and grants funds for the survey of overseas markets.

The first consignment of Japanese transistor portables imported by Winter Trading Co. on arrival by B.O.A.C. at London Airport.

Testing Multi-wire Cables

A SMALL portable test set for "vetting" multi-wire cables *in situ*, or prior to installation, was demonstrated recently by de Havilland Propellers. Designed initially for testing cable looms in aircraft the possibility of it having applications wherever multi-wire cables were in use subsequently became apparent. Many such cables are employed in radio and radar installations at airports, in vehicles and elsewhere. Testing is carried out from one end of the cable but access is necessary to the remote end where the cable has to be fitted with a special adaptor. If the conductors of the cable have different destinations at the remote end the tester can still be used provided all leads are joined to a common point, such as earth.

The cable to be vetted is joined to the test set by a multi-way connector and testing is initiated by press-button switches, one for insulation test and another for continuity check. The unit selects each core of the cable in turn, applies a test voltage and samples the current, if any, flowing in it.

A transistor d.c. to a.c. convertor generates a 1-kc/s square wave which is rectified and provides 500 volts d.c. for insulation test and h.t. for two cold-cathode trigger tubes (Z803U), also a low-voltage current for continuity testing.

One Z803U is used as a timer for pulsing the selector mechanism and the other for sampling the current flowing in the cores under test. This current flows through a resistor and the volts dropped across it are applied to the trigger tube. If the insulation resistance is below a predetermined value (normally less than 2.5MΩ), the voltage across the source resistor will rise to a value sufficient to trip the sampler trigger tube which then energizes a relay and stops the selector mechanism. The identification letter of the faulty core which brought the testing sequence to rest is illuminated and can be seen through one of the inspection windows.

On successfully completing a test sequence the mechanism stops and an indicator lamp, which was illuminated when the testing commenced, is extinguished. Re-starting the test sequence is effected by a third press-button switch.

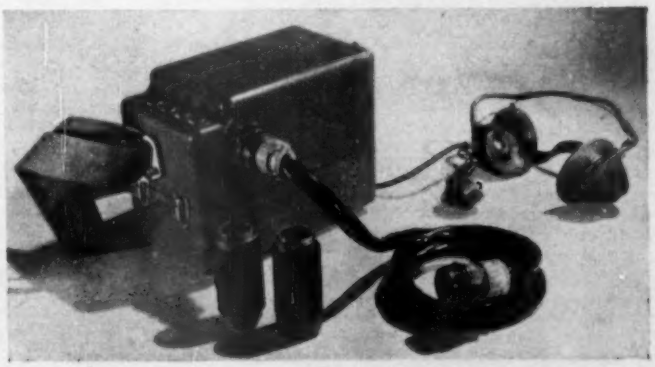
Continuity testing is carried out in a similar way except that the *absence* of current through the source resistor is made to trip the trigger tube.

Two transistor speech amplifiers are incorporated and used to provide two-way telephone communication between the ends of the cable, a useful facility when testing very long cables.

In portable form operating power is provided by a 24-volt unspillable accumulator housed in a container clipped on to the base of the main unit. This gives 16 hours of operation on a single charge. At fixed sites where a.c. is available the battery unit can be replaced by a mains unit of the same size.

A test sequence covers 25 conductors but a larger number can be handled by means of special adaptors.

The equipment measures 11in × 6in × 8½in, weighs 19 lb and is made by de Havilland Propellers Ltd., Hatfield, Herts.



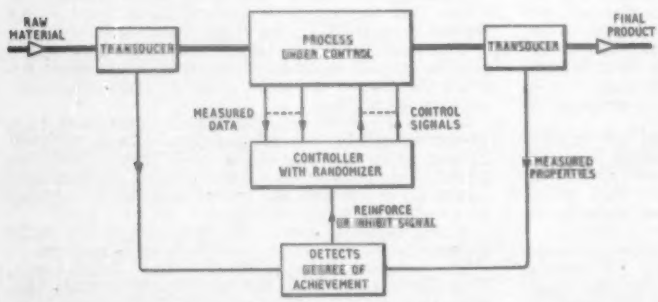
Automatic multi-wire cable tester (de Havilland).

LEARNING MACHINES

NEW ERA OF CONTROL SYSTEMS FORESHADOWED AT N.P.L. SYMPOSIUM

IN certain aspects the symposium held recently at the National Physical Laboratory on "The Mechanization of Thought Processes" had links with the Electronic Computer Exhibition (reviewed on page 17 of this issue). But broadly speaking the machines which formed the real centre of interest at Teddington were totally different from those on show at Olympia. The electronic computer is capable of doing arithmetic at incredibly high speeds, but it is a passive slave whose actions have to be determined in advance by a human programmer. The jargon word for it, borrowed from philosophy, is "deterministic." By contrast, the machines described at Teddington were capable of solving problems which the designers themselves could not solve. As distinct from the "deterministic" computers they worked on "probabilistic" principles, rather as human beings do when making intelligent guesses.

The main practical interest in these "intelligent" machines is the possibilities they seem to offer of new and advanced forms of process control in industry, as well as automatic piloting in aircraft and so on. In particular, the ones known as "learning machines" have the advantage over existing control systems of being able to profit from past experience by a trial-and-error method of working. As a result they should be capable of controlling industrial or other processes which do not lend themselves to precise mathematical analysis.



Block diagram of an industrial process controlled by a learning machine

In essence the mode of operation of the learning machine is to tentatively try various patterns of control action in a random fashion and to reinforce those which give satisfactory results and inhibit those which give unsatisfactory results.

An outline illustration of how this would work in practice was given at the symposium by A. M. Andrew in his paper "Learning Machines." The block diagram shows the essentials of a continuous-process industrial control system with raw materials flowing in on the left and the final product emerging on the right. Variables such as temperatures, pressures and flow-rates are regularly monitored and the information is used by the "controller" to make suitable corrections to the process. The transducer on the right measures to what extent the final product has the desired properties (which might be, say, quality or quantity).

So far this is quite conventional, but the "controller" also contains a "randomizer," the purpose of which is to try different methods of interpreting the measured information. More precisely it varies the values of the mathematical functions by which the controlling signals are related to the monitoring signals.

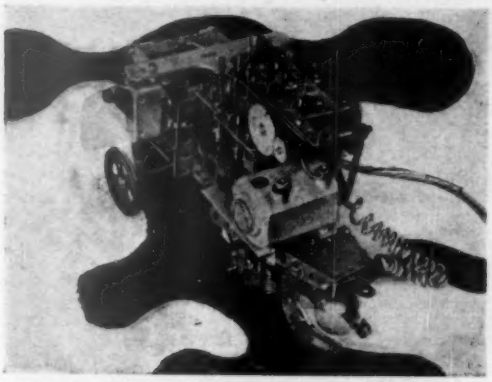
When the final product tends towards the desired properties as a result of a fortuitous trial by the "randomizer," the transducer on the right causes a signal to be sent to the "controller" which reinforces the control action leading to this result. If the product tends in the other direction because of an unlucky random trial, an inhibiting signal is sent to reduce the control action giving rise to the unwanted tendency. This "approval" or "disapproval," as it were, of the randomly selected control patterns may also be made partly a function of the raw material properties, as indicated by the transducer on the left.

Thus the learning system adjusts itself, not, as in a conventional control system, by using predetermined functions of the physical variables, but by using any convenient functions which lead to optimum conditions in the final product.

The terms "reinforce" and "inhibit" used in the foregoing are just convenient words to describe the processes concerned. Dr. Andrew suggests several different methods of instrumenting them in his paper. Some are based on the conditional probability computer described briefly in our September, 1958, issue (p.439). The method here is to discover on a statistical basis what patterns of control action (applied to some of the computer inputs) are associated with goal-achievement signals from the final-product transducer (applied to another input). This type of computer, however, works on a two-state "yes-no" principle and is not really suitable for continuously varying quantities.

A more straightforward method of association, which Dr. Andrew is hoping to use in practice, is based on correlation computing*. Here the idea is to making running correlations between the degree of goal-achievement in the final product and the values of the random mathematical functions tenta-

* See "Recovering Hidden Signals" by James Franklin, in *Wireless World*, March 1955 issue, for background to this technique.



An "intelligent" mechanical tortoise following a boundary by means of a learning machine (connected to the wires leading off to the right)

tively tried out in the "controller" of the block diagram. If there is a positive correlation between the variation of one of these values and the variation in the final goal-achievement then the learning system increases the value concerned (i.e. reinforcement). Conversely if there is negative correlation the learning machine decreases the value (inhibition).

As was mentioned in the September, 1958, issue the conditional probability computer has been demonstrated, purely for illustrative purposes, as the "brain" of a mechanical tortoise which follows a complicated boundary between black and white areas (see picture). Here the learning system forms associations between the "black" or "white" signals the tortoise picks up from its photo-electric receptors and the corresponding signals indicating the "right" or "left" movements which it makes to regain the boundary. As in the industrial process control system, the correct associations are formed by applying reinforcing or inhibiting signals to the control patterns according to the degree of goal-achievement (in this case, regaining the boundary). Thus the tortoise can learn different patterns of association between its sensory perceptions and its motor activity. As a result it can cope with situations such as reversal of the positions of the black and white areas or reversal of the steering linkage.

Similar flexibility of action is achieved by this type of learning machine in another sphere of "intelligent" automation—the recognition of patterns. This will have practical application in devices for translating, say, hand-written characters into speech or print, speech into typescript, or similar visual or acoustic stimuli into mechanical activity. The great problem in pattern recognition is to be able to imitate the human faculty of recognizing patterns even if badly distorted or placed in unfamiliar positions or circumstances. Most people can recognize V in a normal line of type as being an A upside-down, but a character-recognizing machine working on purely "deterministic" principles† would, with all due respect, be completely lost. Not so a "learning" character recognizer of the kind now being developed by W. K. Taylor‡ at University College, London. Here the general principle is that the machine learns to classify various distorted or unfamiliar versions of the patterns with the normal forms, so that on the occasions when a distorted or unfamiliar version is presented to the recognizer it still gives the correct output signal.

The machine uses a matrix of photomultipliers as an "eye" to analyze the pattern presented into small black and white areas. The learning mechanism itself, based on a study of the octopus, consists of 30 electronic units which are really analogues of nerve cells. These are connected together to permit an action corresponding to the "facilitation of synapses" which is thought to be a possible basis for learning in animals and humans. It simply means that certain junctions between nerve cells have their ability to transmit nerve impulses increased by the process of learning, and the pattern of these "facilitated" transmission paths is a stored representation of what is learned—a memory.

Such a learning machine as this is already too cumbersome for practical character recognition—not to mention the new version with 4,000 model nerve cells which Dr. Taylor is now building. But once a pattern of transmission paths has been learned for a particular character-recognizing application, this can be built into a much simpler machine as a permanent and static "memory."

A small machine of this kind, which can be considered as a "frozen" version of the learning machine, with no powers of self-improvement, was described by Dr. Taylor in his paper "Automatic Control by Visual Signals." Instead of the photomultiplier "eye" it uses a television-type scanning system, but it does not, like certain other character recognizers, analyze the picture elements on a two-state basis which says that each one is either "black" or "white." It preserves the analogue nature of the picture elements, containing as they do varying proportions of black and white, right up to the final stages of the recognition process. This is claimed to give improved results because the output signal produced by a distorted character is only reduced in approximate proportion to the amount of distortion and still remains active unless the pattern has a new significance or reaches 100% distortion.

Incidentally, those purists who object to anthropomorphic terms being applied to mechanical devices would have been highly shocked at this symposium. Words like "thinking," "learning," "intelligence," "memory," "recognition" were bandied about quite freely by scientists who (some might think) ought to have known better. It was probably Dr. A. M. Uttley (Superintendent of the Control Mechanisms and Electronics Division of the N.P.L.) who set the tone of the occasion. He remarked right at the beginning that if we allow such terms as "flying" applied to aeroplanes there was no reason to object to "thinking" applied to certain other machines. Somebody else, by way of support, whispered "calculating"—no doubt remembering the electronic computing machines at Olympia.

† "Reading by Electronics," *Wireless World*, April 1957 issue.

‡ See "The Nuffield Foundation Thirteenth Report," Oxford University Press (1958), page 2.

"Data Processing" is the self-explanatory title of a new non-technical quarterly for management and executives being issued by our publishers. In the first issue, to be published in January, the emphasis is on electronic computers. A year's subscription (4 issues) is £4.

Radio Hobbies Exhibition

Wide Field Covered by Amateur and Commercial Exhibits

THE R.S.G.B. stands held some examples of equipment showing an exceptionally high degree of craftsmanship. The winner of the Silver Plaque Award for the most outstanding piece of amateur-built equipment in the show was K. R. Clarke (G3KRC); for a set of unit-constructed test equipment comprising: 2½ in. c.r.o. with pushpull x and y amplifiers and a crystal calibrator, sine-wave oscillator (3c/s to 300kc/s), a.m./f.m. signal generator with crystal check, valve voltmeter, r.c. bridge, 22-range multi-meter, and power supplies for the individual units, all dovetailed together to occupy a volume only 13in × 7in × 20in.

The item which caught our eye in the Mobile Group's display was C. H. L. Edwards's (G8TL) multi-band equipment. This is made up of beautifully-engineered units, the 160m to 10m transmitter and receiver being fitted with plug-in pre-aligned coil boxes for each band. The transmitter uses a Tesla oscillator (this resembles a Colpitt's with the feedback taken from a capacitive potentiometer in one leg of the capacitive network across the coil) which gives good frequency stability: the power unit utilizes separate motor-generators for receiver and transmitter and it includes an a.c. power pack.

C. H. L. Edwards's mobile equipment in position in his car. (Since this photograph was taken the microphone has been fitted to a floor stand so that it can be swung out of the way when not in use.)

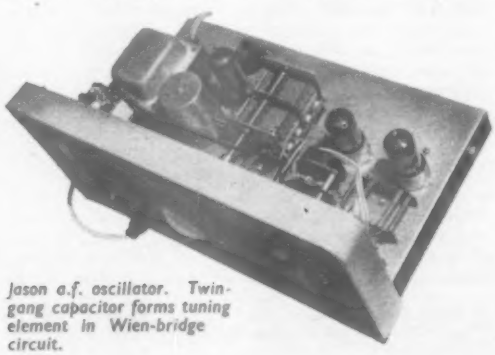
Silver Plaque Award winning entry—K. R. Clarke's unit-constructed test equipment. R.C. bridge is at rear and plaque conceals valve voltmeter.

The V.H.F./U.H.F. Group caters for amateurs with interests mainly in the allocations above 30Mc/s. Two items noticed here were H. F. Smith's (G2DD) neat and small transmitter/receiver with plug-in "front-end" and transmitter sections and a 3-cm test bench (D. Hayter, G3JHM). The receiver section of G2DD's gear is a triple superhet, the i.f.s being 28-32Mc/s (tunable), 7.3Mc/s and 465kc/s, and it includes a noise limiter.

The Armed Services were represented—the Royal Navy by the Royal Naval Reserve, the Army by two Royal Signals Regiments (one regular, the other T.A.) and a club station, and the R.A.F. by the Royal Air Force Amateur Radio Society. An attraction to potential recruits to the R.N.R. is the fact that a modified CR100 receiver fitted with a small (5-W) transmitter is loaned to ratings who qualify as an "Operator 2nd Class" so that training may be carried out at home.

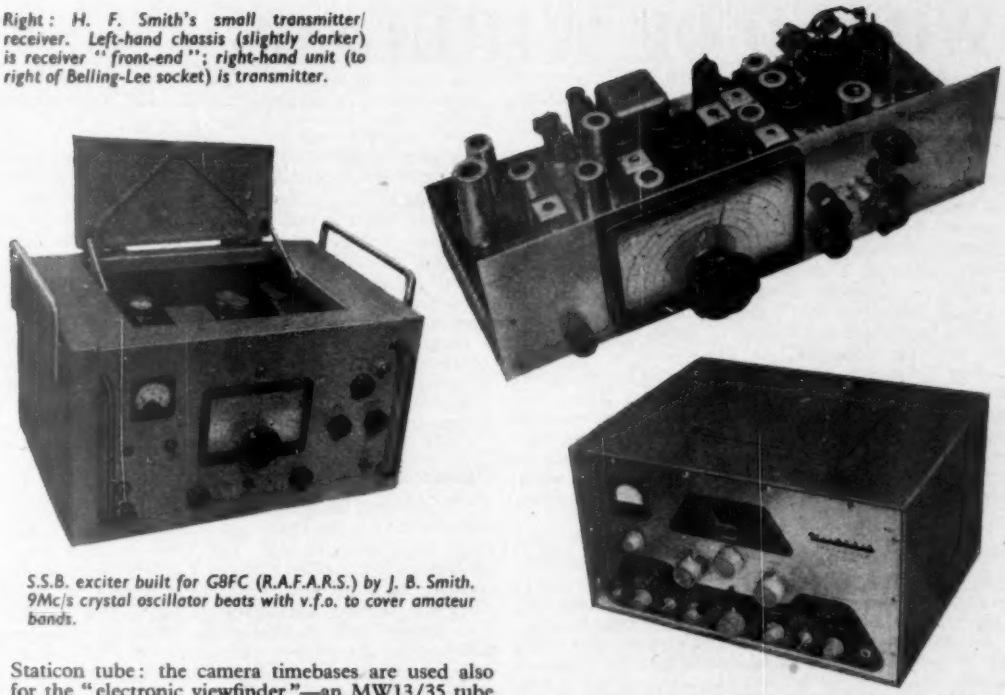
On the R.A.F.A.R.S. stand was a self-contained s.s.b. exciter built by J. B. Smith (G3HSR) for the headquarters station, G8FC. This exciter uses the outphasing method of modulation and the output stage (829B double tetrode) can provide up to 100-W output with an external power supply (25W with internal power supply). G3IRS (like G8FC, from R.A.F. Locking) was operating on two metres at the exhibition as G3IRS/A. With a 150-W output, this station, near Weston-super-Mare, works a regular schedule with PE1PL (Holland)—350 miles away.

The field of television was represented by the British Amateur Television Club and Bush Radio, Ltd. The B.A.T.C. were producing some excellent pictures with a camera made by J. Jull (G3MHZ). This is fitted with a lens turret and uses a 1-in



Jason a.f. oscillator. Twin-gang capacitor forms tuning element in Wien-bridge circuit.

Right: H. F. Smith's small transmitter/receiver. Left-hand chassis (slightly darker) is receiver "front-end"; right-hand unit (to right of Belling-Lee socket) is transmitter.



S.S.B. exciter built for G8FC (R.A.F.A.R.S.) by J. B. Smith. 9Mc/s crystal oscillator beats with v.f.o. to cover amateur bands.

Staticon tube: the camera timebases are used also for the "electronic viewfinder"—an MW13/35 tube mounted on the camera. Several improvements have been made in the Bush receivers, one being "balanced-waveform" dynamic convergence. Previously convergence adjustments were difficult because altering the convergence waveform changed its mean level and this upset static convergence. The balanced-waveform principle utilizes a waveform which is held symmetrical about a mean level: an alteration occurring in the current waveform does not change this level so that the mean current through the deflector coils, and thus the static convergence, is not affected.

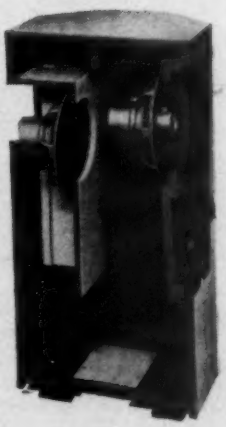
Those who prefer to make up equipment from a kit of parts were given a wide choice at the exhibition. Jason were showing several new instrument kits including a valve voltmeter, an f.m. "wobbulator" and an a.f. oscillator. The a.f. oscillator is a capacitance-tuned Wien bridge with a cathode-follower output and a squarer (cathode-coupled flip-flop). This, like most of the Jason equipment, is housed in a very neat grey-green case having a surround which projects far enough to protect the front panel and controls.

On the Heathkits stand (Daystrom, Ltd.), equipment shown included a 2×8-W stereo amplifier, a loudspeaker enclosure and two transmitters. One of these, the DX100, gives a nominal 100-W output on telephony in the 160m to 10m amateur bands. A Clapp v.f.o. is used with provision for crystal operation and a s.s.b. adapter: band selection is accomplished by a single knob.

On the Stentorian stand a 300-mW transistor amplifier was producing an impressive volume. This is designed to cover the range 100-7,000c/s and it uses a pushpull OC72s to feed directly a 30-Ω loudspeaker. The audio input required for full output is about 0.3V and the amplifier is available either as a "wired" printed-circuit board requiring only the fitting of the four transistors or as the board alone. Another kit which would be suitable for the beginner is the Cossor 701K f.m. receiver. This, complete with a 10in×6in loudspeaker, costs £15 15s and takes about 10 hours to assemble. A spare piece of printed-circuit board is included for the constructor to practice soldering.

DX100 (Heathkit) 15-valve 100-W transmitter for amateur bands. The Modulator uses a pair of KT88s in the a.f. output stage.

G.E.C. "Octagonal Periphonic"



Introduced at the Northern Audio Fair by the G.E.C., the "Octagonal Periphonic" loudspeaker system illustrated here has had its cabinet vertically cut in half to show the loudspeaker positions and interior construction. A rectangular pipe, together with the port at the back near the top of the pipe and cabinet, provide an air load at low frequencies for the speakers. As in the original "Periphonic" system, a considerable reduction in second harmonic distortion at low frequencies is obtained by mounting the two speakers front to back and, in addition, connecting them out of phase.

WORLD OF WIRELESS

TV in Orkneys

TEMPORARY transmitters having been installed at the sites of the two proposed B.B.C. television stations in N.E. Scotland, the stations are being brought into service before Christmas. The Caithness station at Thrumster, near Wick, came into service in Channel 1 on December 15th. The Orkney station at Netherbutton was scheduled to open a week later in Channel 5. Both transmissions are vertically polarized.

The Thrumster station will receive its programmes by radio from the Meldrum station. The programme for the Orkneys transmitter will eventually be picked up direct from the Thrumster station, but while this transmitter is operating on low-power it has been necessary to set up a microwave relay station to convey the programme from Thrumster to the Orkneys.

The temporary stations will serve Kirkwall and Wick and their immediate surroundings, but the permanent transmitters, due for completion by next autumn, will serve almost the whole 43,000 population of the Orkney Islands and Caithness.

A temporary v.h.f. sound transmitter operating on 93.7 Mc/s has also been installed at the Netherbutton site.

Physical Society Exhibition

AS already announced, the Physical Society's forty-third exhibition of scientific instruments and apparatus opens at the Royal Horticultural Society's Halls, Westminster, on January 19th for four days. Tickets are obtainable free from exhibitors or the Society.

A large number of universities, hospital physics departments and research organizations are participating in the Exhibition in addition to the manufacturers listed in our last issue. Incidentally, it is regretted that two manufacturers in our field were omitted from the list: Advance Components and Decca Radar. By invitation of the Society, a collection of instruments from Swedish universities and research organizations is being shown.

Readers unable to visit the show may like to obtain the Exhibition Handbook, which is a valuable book of reference on scientific instruments and is available from the Society (1, Lowther Gardens, London, S.W.7) at 6s (postage 1s 8d).

Student Exchange

THE eleventh annual report of the International Association for the Exchange of Students for Technical Experience records that 5,394 students were exchanged between 24 member countries during the summer vacation last year. This brings the total since the scheme was introduced to nearly 40,000.

Germany heads the list of countries, having sent 998 students abroad last year and received 1,023 from other countries. From the U.K. 774 students went abroad and we received 829.

Although in the report radio and electronic engineering is covered under the heading electrical engineering, it is obvious from the list of companies accepting students both in this country and abroad, that many of the 855 "electricals" (which was the second highest category in the table of "Academic Spheres of Influence") are taking light-current engineering.

ANGELA FIRMAN who, at 18, recently obtained the P.M.G.'s first class certificate in radiotelegraphy after studying at the North Eastern School of Wireless Telegraphy, Bridlington, may now serve as a marine radio officer. Although she is the only woman in the U.K. to hold a valid first class certificate she is not the first to do so; Mrs. G. M. Bond (née Vale) obtained one in 1948 from the Colwyn Bay Wireless College.

Welsh V.H.F.—The opening of two new stations at Llanddona, Anglesey, and Llangollen, Denbigh., on December 20th brings the coverage of the B.B.C. v.h.f. sound service to approximately 92% of the population of Wales. Llanddona, replacing the temporary v.h.f. transmitter at Penmon, radiates on 89.6, 91.8 and 94 Mc/s, with an e.r.p. of 2kW. Llangollen's carriers are 88.9, 91.1 and 93.3 Mc/s and its e.r.p. 6kW. The B.B.C. now has 17 permanent v.h.f. sound broadcasting stations in use, all of which use vertical polarization.

Space Research.—The International Council of Scientific Unions has set up a Committee on Space Research (COSPAR). Seven countries, including the U.S.S.R., and the U.S.A., and a number of international bodies were represented at its first meeting in London in November, at which Professor H. S. W. Massey, of University College, London, was elected to the executive committee.

A.T.E.C.—A council, to be known as the Air Transport Electronics Council, has been formed with representatives from the E.E.A., the Society of British Aircraft Constructors, B.O.A.C., B.E.A., and British Independent Air Transport Association. Its aim is the "standardization of civil aircraft radio equipment and systems installations and to promote development of systems for future air operating requirements." J. S. Simpson, of International Aeradio, has been appointed secretary of the Council, which has offices at 37, Park Street, London, W.1 (Tel.: Hyde Park 5024).

Marine Radio Telephony.—The third station providing a v.h.f. radio-telephone link between U.K. subscribers and ships comes into service in January. It will operate from the Niton, Isle of Wight, station and will cover ships within a radius of about 50 miles from St. Catherine's Point. The frequencies to be employed are 156.8Mc/s (calling) and a two-frequency traffic channel using 161.85Mc/s for transmission and 157.25Mc/s for reception. Similar facilities are already provided in the Firth of Clyde and from North Foreland and further services are planned for the areas covered by the stations at Lands End and Mablethorpe (Humber).

Mullard Amateur Award.—A yearly award of equipment or books to the value of £25 is being presented by Mullard to the U.K. member of the R.S.G.B. who has "through the medium of amateur radio during the preceding calendar year rendered outstanding personal service to the community by his own endeavours or by his own example of fortitude and courage." Nominations for the award, to be presented in April, must be submitted by three members of the society in January.

R.S.G.B. Report for the year ended last June, presented at the annual meeting on December 12th, records for the second successive year an increase in membership. The increase was 600, giving a total membership of 9,095. At the end of last June there were 8,190 amateur sound licences in force in the U.K. and the holders of 5,898 were members of the society.

R.A.F. Signals.—The status of No. 90 Signals Group has been raised to Command level and will in future be known as Signals Command with its headquarters at Medmenham, Bucks. The present Air Officer Commanding, A.V-M. L. Dalton-Morris, is continuing in command of the formation.

Twenty-first Annual Dinner of the Royal Flying Corps Wireless Operators Old Comrades Association will be held in London on March 14th. Details are obtainable from E. J. F. C. Hogg, 57, Hendham Road, London, S.W.17.

I.T.A. in the North East.—Full-power test signals have been radiated from the Burnhope, Co. Durham, station of I.T.A. since the beginning of December in preparation of the start of programme transmissions on January 15th. The transmitter, operating in Channel 8, has an e.r.p. of 100 kW to the N.E. and S.E., 70 kW to the East and 20 kW towards the West.

Receiving Licences.—New combined television and sound licences issued in the U.K. in October numbered 147,979 bringing the total to 8,571,491. Sound-only licences are now down to 6,159,192 (including 360,286 for car radio), giving an overall total of 14,730,683.

Indian Receiving Licences.—Changes in the administration of broadcast receiving licences were introduced in India at the beginning of November. A licence is needed for each set in a household and it is now necessary to present a licence in order to buy a set. The counterfoil of the licence is retained by the dealer. A licence is now transferable with a set.

London U.H.F. Group.—The annual dinner of the Group will be held at the Bedford Corner Hotel, Tottenham Court Road, W.1, on Saturday, January 31st.

TV Photographic Competition.—*Amateur Photographer* is organizing a competition for end-of-tube television photographs. Half-plate prints of six different subjects showing the full screen mask and made from 35mm negatives taken during December and January must be submitted. Details of the competition were given in the November 26th issue of *Amateur Photographer* and instructions for posting will be given in the February 4th issue of that journal.

"Medium-Wave News" is the title of a duplicated four-page news sheet prepared by a group of medium-wave DX enthusiasts. It is published by Bernard Brown, 196, Abbey Street, Derby, and costs 4s for the six monthly issues (November to April).

Jodrell Bank.—An appeal for £150,000 to meet the deficit on the cost of the radio telescope at Jodrell Bank, estimated at some £680,000, has been launched by Manchester University. The telescope forms part of the University's Jodrell Bank Experimental Station, of which Professor A. C. B. Lovell (Professor of Radio Astronomy at the University) is director.

Medical Electronics Group has been formed within the Brit.I.R.E. with W. J. Perkins as chairman. The first of the five meetings to be held during the present session will be on January 23rd, at which Dr. A. V. Hill, C.H., F.R.S., Emeritus Professor of Physiology at University College, will be the speaker.

Brit.I.R.E. Council.—As already announced, Professor E. E. Zepler is the new president of the Brit.I.R.E. Newly elected vice-presidents are A.V-M. C. P. Brown and Col. G. W. Raby. Other new members of the Council are A. A. Dyson, H. F. Schwarz, Professor D. G. Tucker, Dr. T. B. Tomlinson and Major P. A. Worsnop.

Paris Components Show.—The dates of the Paris Components Show, announced in our last issue, have been changed from March to February 20th to 24th.

E.I.B.A.—Donations from a number of radio and electronics firms are acknowledged in the report and accounts of the Electrical Industries Benevolent Association for 1957 just published. The Radio Industry Council gave £500; the Radio Industries Club (London) £420; and the B.B.C. £105. The income of the Association, which was formed in 1908 to assist directly or indirectly any deserving or necessitous persons (excluding manual workers) in the electrical industry, increased by nearly £10,000 compared with the previous year.

New Radio College.—Opened in the spring of 1958 as a training college for Merchant Navy radio officers, R.M.S. *Wray Castle* at Ambleside, Westmorland, has been given recognition by the Post Office for the training of candidates for the P.M.G.'s certificate. The principals are R. S. Tomlinson and A. W. Wood, who are also principals of the College of International Marine Radiotelegraphic Communication, Manchester, and the chief instructor is F. M. Webber. The marine radio equipment for the college was supplied by Siemens Edison Swan.

Presentation of Technical Information.—Among the advanced courses in electrical and mechanical engineering outlined in the syllabus for the 1958/59 session issued by the Manchester and District Advisory Council for Further Education is one of eight lectures on the presentation of technical information. It will be given at the Manchester College of Science and Technology on Tuesday and Wednesday evenings from February 17th.

Audio Lectures.—A course of 12 lectures on sound recording and reproduction begins at the Southall Technical College, Middlesex, on Monday, January 12th at 7.0 (fee £1).

Control Engineering.—A course of 10 evening lectures on linear and non-linear servo-controlled systems will be given on Wednesdays from January 21st at the South East London Technical College, Lewisham, S.E.4 (fee £1).

Industrial Electronics.—A six-months' full-time course in industrial electronics for mechanical engineers begins at the South East London Technical College on January 5th (fee £17).

I.G.Y. Juvenile Lectures.—The opening lecture in the series of six on the International Geophysical Year being given during the Christmas holiday at the Royal Institution will be on the ionosphere and the I.G.Y. It will be presented by J. A. Ratcliffe, F.R.S., of Cavendish Laboratory, on December 30th. The third lecture, on the exploration of the upper atmosphere, will be given on January 3rd by Dr. R. L. F. Boyd, of University College.

Radio Hobbies Exhibition.—Nearly 10,000 people visited the Exhibition during its four-day run at the R.H.S. Hall, London, S.W.1.

Personalities

G. G. Gouriet, A.M.I.E.E., has left the B.B.C., where he has been head of the television group in the Research Department for some years, to become a director of Wayne Kerr Laboratories, Ltd. He joined the B.B.C. Engineering Division in 1937 and after five years in the Operations and Maintenance Department transferred to the Research Department. Initially he was concerned with transmission problems, including the study of modulation systems which led to the decision to adopt f.m. for the B.B.C. v.h.f. service, but since 1946 he has specialized in television research. Mr. Gouriet, who is 41, has undertaken considerable research and investigation into colour transmission systems and recently delivered a lecture on the subject to the Royal Institution. His interests, however, lie in the broader field of communications embracing information theory, measurement and control problems. He received one of the R.I.C.'s technical writing prizes in 1954 for his article on spectrum equalization in our sister journal *Wireless Engineer* (now *Electronic & Radio Engineer*).

G. G. GOURIET.

W. J. BRAY.

W. J. Bray, M.Sc.(Eng.), M.I.E.E., who, as announced last month, was recently appointed staff engineer in charge of the Inland Radio Branch of the Post Office Engineering Department, has been elected International Chairman of Study Group IX of the International Radio Consultative Committee (C.C.I.R.), in succession to **H. Stanesby,** who has resigned following a reorganization of work in the Engineering Department of the Post Office. This Study Group of the C.C.I.R. is concerned with standardization of line-of-sight and tropospheric-scatter radio-relay systems. The Post Office branch, of which Mr. Bray is now in charge, is responsible for the planning and provision of radio-relay systems and mobile radio systems, and for broadcasting and radio interference matters.

Dr. T. S. Moss, of the Radio Department of R.A.E., who has carried out much original experimental and theoretical work on the properties of semiconductors, and **P. R. Wallis,** B.Sc., A.M.I.E.E., of the Admiralty Signal and Radar Establishment, where he has been responsible for much of the development of radar techniques for guided weapons, have been promoted senior principal scientific officers in the Scientific Civil Service.

D. J. Davis, who since his demobilization in 1945 has been technical sales engineer with Avo, Ltd., has joined British Physical Laboratories as sales manager. He succeeds **D. G. Ashton Davies,** who has joined E.M.I. Electronics.

C. L. Richards, B.Sc., A.C.G.I., A.M.I.E.E., for the past nine years with E.M.I., where recently he has been associated with computer design, has joined Painton & Co., of Northampton, as chief engineer. Mr. Richards joined Philips in 1932, and after two years went to Eindhoven, Holland, where for five years he was in charge of the television receiver design laboratory. He returned to England in 1939 and for ten years was head of the Philips Television and Radio Set Development Laboratory in this country.

C. L. RICHARDS.

E. V. D. Glazier, Ph.D.(Eng.), B.Sc., A.M.I.E.E., Director of Scientific Research (Electronics and Guided Weapons) in the Ministry of Supply, since 1957, was recently promoted to the rank of deputy chief scientific officer in the Scientific Civil Service. Dr. Glazier, who was born in 1912, received his early training in electrical and mechanical engineering in industry, and joined the Post Office in 1933. For the ensuing nine years he was engaged on the development of telephone systems. In 1942 he was transferred to the Signals Research and Development Establishment. He became head of the Line Communication Group in 1946 and in 1950 he was put in charge of the Research Division at S.R.D.E., Christchurch. He is secretary of the Radar and Signals Board of the Minister's Advisory Council on Scientific Research and Technical Development.

A. V. Olorenshaw, B.Sc.(Eng.), who was until a few months ago sales manager of Wayne Kerr Laboratories Ltd., has become a director of Metrix Instruments Ltd., of Surbiton, Surrey, which was formed a few months ago to handle Continental instruments.

S. C. Heward, B.Eng., A.M.I.E.E., who has been with Marconi's since 1937 when he joined them as an installation engineer, is appointed manager of the Associated Companies Division. He will be responsible, within the export department, for technical liaison with the overseas associates of the company.

G. T. Kelsey, O.B.E., Marconi's London representative for the past 18 months, is appointed manager of the company's London office. For some years prior to joining Marconi's eight years ago as assistant to the manager of the radar division, he was with E.M.I. In recognition of his war-time services in the Radar Branch of the R.A.F., he was appointed an O.B.E.

S. C. HEWARD.

G. T. KELSEY.

E. G. Parramore, Plessey's representative in Amsterdam, has been honoured by Queen Juliana of the Netherlands with the Knighthood of the Order of Orange-Nassau in recognition of his distinguished services to the Netherlands aircraft industry. Before joining Plessey in 1956, he was for three years director of the Hunter Aircraft Construction Office in The Hague.

J. E. Attew, A.M.Brit.I.R.E., until recently with Peto Scott where he was engineer in charge of television transmission equipment, has joined the video division of Epsylon Industries as chief project engineer. He was recently appointed a member of the Brit.I.R.E. committee to organize the 1959 convention which will be devoted to techniques and applications of television.

Gordon L. Ball, B.E., Grad.I.E.E., has been appointed general sales manager of Wayne Kerr Laboratories in succession to A. V. Olorenshaw. Throughout the war he served in the Royal Canadian Signals Corps in which he held a commission as Captain. After the war he studied at McGill University where he obtained his Bachelor of Engineering degree. Since settling in this country in 1950 he has been sales manager of the components division of the Plessey Company.

OUR AUTHORS

Francis Oakes, A.M.I.E.E., A.M.Brit.I.R.E., a frequent contributor to *Wireless World*, who with **D. V. Charlesworth** writes on stereo pickups in this issue, is engineer in charge of Ferguson's radio and transistor applications laboratories. He has been with Ferguson's for some years, prior to which he was assistant chief of the electronics laboratory of the Morgan Crucible Co. D. V. Charlesworth is senior development engineer in Ferguson's radio laboratory where for several years he has specialized in the design of audio equipment.

C. Speight, who writes on the Miller sweep circuit in this issue, is on the staff of the U.K. Atomic Energy Authority but the article is the result of research and development carried out privately. He is 20.

P. R. Keller, B.Sc., A.M.I.E.E., who with **L. K. Wheeler** writes in this issue on automatic error correction in telegraph systems, is in charge of the section formed by Marconi's in 1956 to develop error-correcting telegraph equipment. Soon after joining Marconi's in 1944 he was appointed to the design and development division for work on radar and marine communication equipment. From 1950 to 1956 he was chief of the Established Designs Section, V.H.F. Develoment Group, responsible for the planning and development of v.h.f. systems and the design of associated equipment.

P. R. KELLER

L. K. WHEELER

L. K. Wheeler, B.Sc.(Eng.), A.M.I.E.E., co-author of "Automatic Error Correction," joined the Post Office Engineering Department in 1933 and has been at the Research Station since 1937 where he is now assistant staff engineer in charge of the Telegraph Section. He is a U.K. representative in two of the Study Groups of the International Telegraph and Telephone Consultative Committee (C.C.I.T.T.).

OBITUARY

Stephen Butterworth, O.B.E., who died recently at the age of 73, was an outstanding mathematician and one of the leading scientists in the Admiralty Research Laboratory, where he served from 1921 until retiring in 1945. The results of much of his work cannot be published and his contributions in the application of science to naval problems are, therefore, largely unknown. For his part in providing the answer to the German magnetic mine he received an award from the Royal Commission on Awards to Inventors. His work on electric filters is perpetuated by the association of his name with a particular type of response. Older readers of *Wireless World* will recall his work on coil design in the mid-1920s which contributed to the development of the famous "Everyman Four" receiver in 1926.

News from the Industry

Siemens Edison Swan is being divided into three divisions: cables, telecommunications and radio and electronic components under a long-term reorganization scheme of the A.E.I. group, of which it is a member. The divisions will be controlled, respectively, by J. S. A. Bunting, W. G. Patterson, and J. W. Ridgeway, who will each hold appointments on the board of A.E.I. Divisional Management Co., Ltd. The telecommunications division which begins operation on January 1st will have F. G. Pheazey as chief engineer. The radio and electronics division will not come into operation until January, 1960.

Racal Engineering, of Bracknell, Berks., have formed an instrument division with its own development laboratories under N. Elson, chief engineer. It includes a special projects section which will "design, manufacture and install digital or non-digital instrumentation schemes." The sales manager of the new division is I. H. M. Campbell.

G.E.C. announce organizational changes covering the production and sale of valves and semiconductors. The responsibility for the sale of all non-domestic valves and cathode-ray tubes, as well as for the photocells, barretters, neon indicators, etc., which have hitherto been handled by the Valve and Electronics Department of the G.E.C., will be taken over by the M.O. Valve Co., Ltd. Domestic valves and tubes will continue to be sold direct to retailers by the G.E.C. Radio Division. The company's semiconductor business will in future be operated from the semiconductor factory at Hazel Grove, Stockport, Cheshire. G. A. Marriott, director of M.O. Valve Co., will direct overall sales policy for both the M.O. Valve Co. and the new Semiconductor Division. A. H. Howe has been appointed general manager of M.O. Valves. C. F. Machin, previously chief engineer in the semiconductor department at the G.E.C. Research Laboratories, is general manager at Hazel Grove, with B. R. Bettridge as commercial manager.

B.I.C.C.-Telcon Link.—The B.I. Callender's Cables Group, which includes among its 15 or so members B.I. Callender's Construction Co., T.C.C., and United Insulator Co., has made an offer to acquire the Telegraph Construction and Maintenance Co., which has itself a number of subsidiaries including Magnetic and Electrical Alloys and Telcon Telecommunications. In association with Automatic Telephone and Electric Co., B.I.C.C. also controls British Telecommunications Research, Ltd.

Solartron.—The report of the Solartron group of companies for the year ended last June records that the year's trading profit is up by some 80 per cent on the previous year. Equipment to the value of £1.43M was sold during the year, twice the volume of two years ago. Exports accounted for over a third of the year's business.

K.G. (Holdings), Ltd., of which Bonochord, Tellux, Perihel and W.S. Electronics are subsidiaries, made a record trading profit during last year. The profit before taxation was £189,226 compared with £145,901 the previous year.

Radio and Television Trust, Ltd., of which Airmec is the only operating subsidiary, had a trading profit before taxation of £104,769 last year, compared with £77,464 in the preceding year. Radio and Television Trust is itself a subsidiary of Crompton Parkinson, Ltd.

Millett Levens.—With the purchase of a controlling interest in the Millett Levens Group, which includes Printed Circuits, Ltd., and Millett, Levens (Engravers), Ltd., of Borehamwood, Herts., the London Electric Wire Company and Smiths, Ltd., announce the appointment of the following directors: E. L. Wildy (chairman), L. Levens and P. Millett (joint managing directors), K. W. Marten and D. R. Cornwell.

Marconi's are supplying two 100-kW twin-channel transmitters employing evaporation cooling to the B.B.C. for installation in the Rampisham, Dorset, station which is used for the overseas service.

E.M.I. Electronics are supplying nine Vidicon camera channels (Type 201) to the B.B.C. for use in interview studios. The camera, which employs printed circuits, is considerably lighter than its predecessors.

B & K Laboratories, Ltd., announce the formation of a new company, B & K Electronic Services, Ltd., at Union Street, London, S.E.1, which will carry out the re-alignment and calibration of instruments, particularly to American factory specification, on a contract basis.

Change of Name.—Newmarket Transistor Co., Ltd., announce that the name of the company has been changed to Newmarket Transistors, Ltd.

B.T.H. and Metrovick.—The London district office of B.T.H. is no longer at Crown House, Aldwych, but at 33, Grosvenor Place, S.W.1 (Tel.: Belgravia 7011), the new headquarters of Associated Electrical Industries. Similarly, the London office of Metropolitan-Vickers has been transferred from St. Paul's Churchyard to the same address.

Metrix Instruments, Ltd., which commenced trading in February, has transferred its offices to 54, Victoria Road, Surbiton, Surrey (Tel.: Elmbridge 2776). In addition to handling equipment manufactured by Metrix, of France, the company are the sole U.K. agents for Metrawatt A.G., Nuremberg; Lemouzy, Paris; and Rochar, France.

Beam-Echo, Limited, makers of Avantic sound reproducing equipment, who are now in the Thorn Electrical Industries Group, have moved their factory to Essex Works, Essex Place, Newhaven, Sussex. Their offices are now at 13 South Molton Street, London, W.1 (Tel.: Mayfair 1039).

Shockley Transistor Corp. has been formed as a subsidiary of Beckman Instruments Inc. Since 1956 Dr. William Shockley has been directing the company's Shockley Semiconductor Laboratory at Palo Alto, Cal., from which the new corporation has grown.

A communal aerial system has been installed for the occupants of the 221 flats in 15 adjacent blocks erected by the Dover (Kent) Corporation. It provides outlets for Bands I, II, and III in each flat. The carrier of the local channel 2 transmitter is converted to channel 1 for distribution (to obviate spurious pickup on receiver wiring) and channel 9 is converted to channel 5 to minimize cable losses. The system was installed by B.A.A. Smye-Rumsby, of Dover and Folkestone.

Pye Telecommunications, Ltd., have developed new ground equipment for I.L.S. (Instrument Landing System) and this was used at the recent demonstration of "no hands" landing reported on p. 579 of last December's issue.

Marconi Instruments, Ltd., are staging an exhibition of their telecommunication measurement equipment at the Waldorf Hotel, Aldwych, London, W.C.2, from January 19th to 24th. Tickets can be obtained from their London Office, Marconi House, Strand, W.C.2. (Tel.: Covent Garden 1234.)

McMurdo Instrument Company have received Inter-Service Quality Approval for their "Red Range" connectors and for their 9-, 18-, 26- and 34-way "Micronectors."

Tape Recorders (Electronics), Ltd., of Tottenham, London, N.17, have been appointed sole distributors for the U.K. for Sonocolor magnetic recording tape which is made on the Continent.

OVERSEAS TRADE

Exports of British radio equipment of all kinds reached their highest monthly level in October. The provisional figure of just under £4.2M brings the total for the first ten months of the year to £36.75M. The month's exports of capital goods were to the value of over £1.5M. The October exports of valves (£536,000) were a record.

Test equipment to be used in the maintenance of radio-telephones employed by the police, fire, ambulance and other services has been ordered from Marconi Instruments by the Telecommunications Administration of Malaya. The order includes thirty v.h.f. signal generators, and the same number of transmitter and receiver output test sets.

Bulgaria's new television station to serve the capital and its environs will have studio, film scanning and transmission equipment supplied by Pye. They are also supplying a mobile unit for the station, which is planned to be brought into service early in 1959.

Industrial television equipment similar to that being supplied for the nuclear power station under construction at Bradwell, Essex, has been ordered from Pye for the first Italian nuclear power station at Latina.

Oryx miniature soldering irons are now being distributed in Canada exclusively by Len Finkler & Co., 1794, Avenue Road, Toronto, 12, Ontario.

France.—Equipments Industriels, of 1 rue Monticelli, Paris, 14, are interested in representing United Kingdom manufacturers of scientific instruments for industrial control, analysis and research.

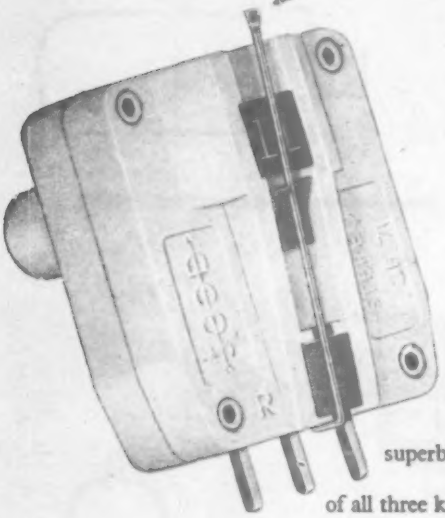
Sweden.—A. B. Teleinvest, of Rosenlundsgatan 8, Gothenburg, wish to represent U.K. manufacturers of miniature components for guided missiles and also printed circuits.

Standard Telephones and Cables Limited

Registered Office : Connaught House, Aldwych, London, W.C.2

VALVE DIVISION · FOOTSCRAY · SIDCUP · KENT

'I'm a plug for stereo'



ACOStereo Cartridge Type 71 will play an important part in bringing first-rate stereo sound to many thousands of enthusiastic hearers. It fits several well-known makes of pick-up arms and plug-in heads, and also serves in the conversion of conventional players to stereo.*

ACOStereo Turnover Cartridge Type 73 achieves superb reproduction of all three kinds of records—stereo, LP and standard. The Type 73 has already been adopted for many of the leading makes of pick-ups in this country (and abroad). As you would expect from Acos, these ACOStereo cartridges, too, are reasonably priced, and combine top value with top performance.

**If you are in doubt where Type 71 can be fitted, please ask us.*

'I do the hat-trick'

acos ARE DOING THINGS IN STYLE

COSMOCORD LTD WALTHAM CROSS HERTS · TEL: WALTHAM CROSS 5206 (London subscribers please dial WA4 5206)

ELECTRONIC COMPUTER EXHIBITION

New Developments in Digital Circuitry and Input/Output Equipment

THE recent Electronic Computer Exhibition held at Olympia marks the end of the first decade of computer development in Great Britain. In these ten years the digital computer has emerged from the chrysalis of university and Government laboratories to become a fully developed and engineered commercial product. There are now over a hundred working installations in this country. Of these the greater proportion consists of "scientific" computers, for the era of business data processing is only just getting under way (with the notable exception of Lyons Electronic Office, operating successfully since 1953).

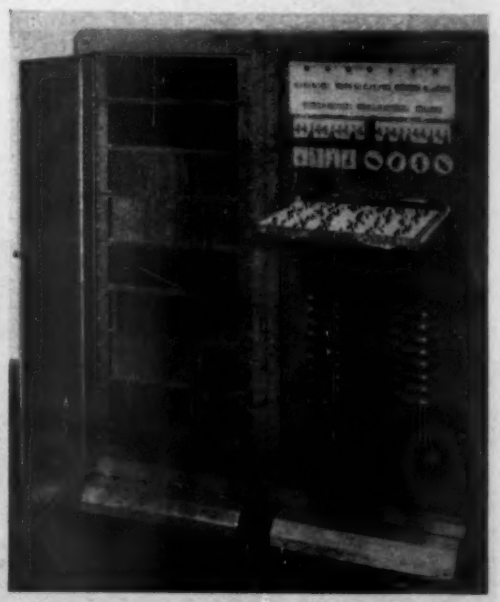
From the electronic engineering point of view it is, of course, the thermionic-valve computer which has now reached the state of a reliable commercial product. A great deal of money has been spent on research and, although everybody knows that transistors are the ideal components for digital computer circuitry, it is likely that the valve machine—for which regular production lines have now been set up—will continue to dominate the market for a good many years to come. This situation may eventually be modified now that several transistor computers have been developed and put on view at the Exhibition. But, even so, the valve computer will have the advantage of lower price for some considerable time.

There is probably no need to remind readers of this journal of the advantages of the transistor for use in the large masses required for digital computers. Being small, it makes possible machines of greatly reduced size. Requiring no heater, it reduces the problem of cooling, avoids the danger of heat affecting other components, simplifies the power supplies, and generally allows the components to be packed tighter together. As for reliability, this is a slightly unknown factor, but it is likely that the transistor will prove at least as reliable as the valve and probably longer-lived.

The main limitation of the transistor so far has been its slow speed of response compared with the valve. In the past this has restricted its operation to pulse repetition frequencies up to about 100kc/s, whereas a good many valve computers work at p.r.fs of several megacycles. Some of the latest transistor machines to be developed are using high-frequency alloyed-junction transistors of the OC44 and 45 types, and these are now making possible pulse rates in the range of 100kc/s-1 Mc/s. When surface-barrier, micro-alloy and other advanced high-frequency types find their way into the computing field the pulse rates will rival those of valve computers and probably exceed them. Indeed, once the problem of obtaining high speed of response is solved (as it will be) the transistor will show a distinct advantage over the valve, because of its inherently low input and output impedances, which will reduce the effects of circuit capacitance on fast pulse rise times.

For some applications where high-speed computing is not required the present available l.f. transistors are quite adequate. An example of this occurs in the exciting new sphere of process control by computers, which manufacturers of data processing equipment and control gear are just beginning to explore jointly. The idea is that the computer is incorporated directly into the control system, taking its input in turn from various measuring transducers distributed about the industrial plant (via analogue/digital converters) and giving outputs which are used to actuate servo-mechanisms for controlling the plant.

Two machines intended for this type of work were shown at the Exhibition. One, made by Ferranti, is being currently investigated as a possible means for the control of boilers during start-up and shut-down operations. A National-Elliott machine is to be used in a data processing and information system for application to a nuclear

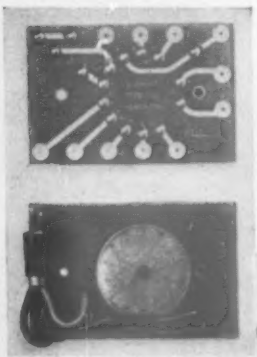


Ferranti process control computer with plug-in printed-circuit cards on the left and control panel and programme trays on the right.

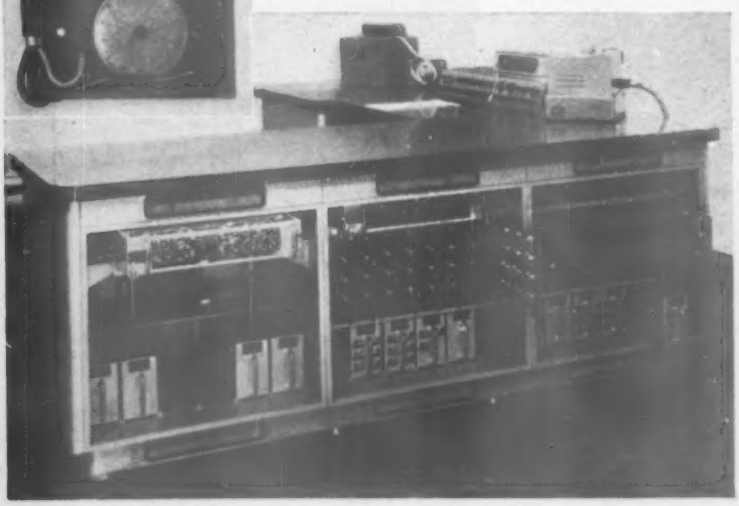
reactor of the U.K.A.E.A. Both are stored-programmed computers and are quite small, as can be seen from the illustrations. The significant point is, though, that the sampling of measurement points in the industrial control system is not done so rapidly that the computing has to be performed in a continuous high-speed stream. In fact, there are pauses between each burst of computing which could possibly be used for other work. As a result the machines have been designed to work in the serial mode (pulses representing binary digits by their relative positions in time), and it is not necessary for the pulse rate, which determines the speed of computing in the serial mode, to be unduly high. Thus, although these machines are operating in what is known as "real time," the "real time" is, in fact, rather slow.

The Ferranti computer actually has a p.r.f. of 500kc/s, and performs addition, subtraction, and other simple operations such as transfer of numbers in 24μsec. More complex operations take longer. The length of the numbers, or "word length," is 10 binary digits (or 20 optional). Each step or instruction in the stored programme consists of a pattern of wiring connections and these patterns are set up by hand as rows of plugs in plug-boards, which are held in trays on the right-hand side of the machine (see picture). Altogether 500 programme steps are available and the computer scans them in turn. They are "single-address" instructions, that is, each instruction specifies in coded form the "address" or storage location of the next number to be transferred into the accumulating register in which the arithmetic operation is to be performed. The instruction also specifies in coded form what arithmetic operation is to be performed. When this is completed the computer automatically selects the next instruction in the plug-board programme.

Magnetic-core matrix store (Mullard) used in many computers for immediate-access storage. The box contains a stack of matrix planes.



National-Elliott 802 desk type computer with covers removed to show printed-circuit boards and the core matrix store (black box). Inset is a basic computing element of the machine, with transistor, core and resistor.



The storage locations referred to are provided by a storage system of the magnetic-core matrix type* using tiny ferrite cores with rectangular hysteresis loops. This has a capacity of 256 numbers of 10 binary digits each, and the interesting point about it is that the windings driving the cores from one state of remanent magnetization to the other are energized by power transistors of the new OC23 type. Transistors hitherto available have not had the required combination of high collector current output and high alpha cut-off frequency necessary for this work, but the OC23 will deliver pulses of about 1 amp and has a cut-off frequency of 2.5Mc/s.

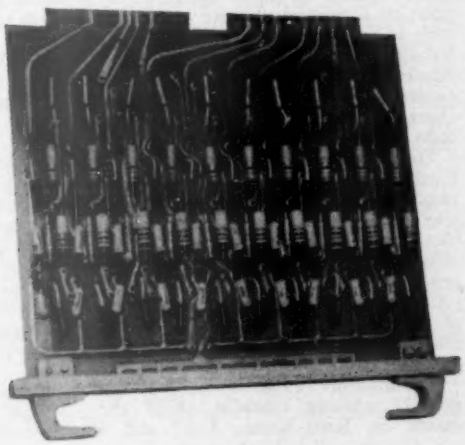
Logical circuitry in the computer is similar to the larger "Pegasus" valve machine made by Ferranti. It is based on "OR" and "NOT" gate-type circuits formed by semiconductor diodes and transistor inverters. The two-state elements used extensively in binary digital computers to provide short-term storage registers are formed by transistor Eccles-Jordan trigger

* See "Magnetism in Materials" by D. H. Martin, *Wireless World*, April, 1958. issue.

circuits. For this kind of operation the OC44 transistor is used. Pulse rise times are about 50mμsec. The computer works on power supplies of +6V, −6V and −24V and its total consumption is only 250 watts.

In the National-Elliott 802 machine the digit pulse rate is 166.5kc/s and the "word length" is 33 binary digits. Addition, subtraction and 46 other orders are performed in 612μsec each. It is again a "single-address" machine, but the programme of instructions is normally fed in by punched paper tape to be held in the magnetic-core matrix store (1,020 words capacity).

The logical circuitry is based on "OR" and "NOT" elements as before, but here two-state magnetic ferrite cores with various sets of input windings and a single output winding are used instead of the diode circuits. According to the logical pattern of input digit pulses applied to the input windings, each core is set into one state or the other, corresponding to "0" or "1" in binary notation, by the coincident magnetic fields. This happens in the first 3-μsec half of the 6-μsec digit-pulse period. A so-called "shift" or "trigger" pulse is then applied to an additional input winding in the second 3-μsec half of the digit-pulse period, and the effect of this is either to switch the core or leave it as it is—depending on how it has been set by the original digit pulse inputs. As a result of this action the output winding either produces a pulse or a space (absence of a pulse), and this is where the transistor enters the picture—to amplify, regenerate and pass on the output pulse to another winding on another core.



Plug-in printed-circuit card for the Emidec 1100 magnetic-core/transistor computer.

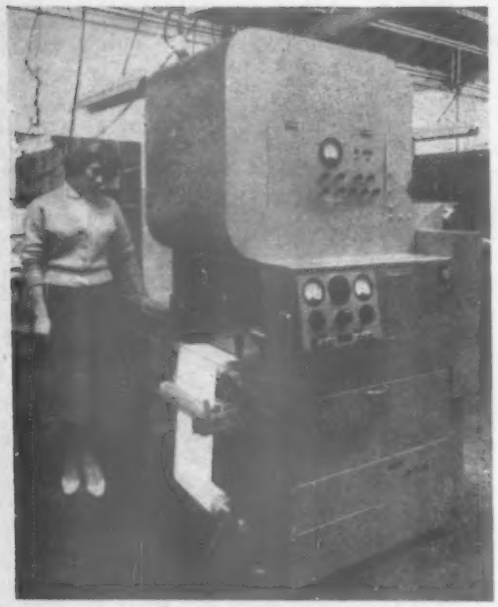
Thus the magnetic-core/transistor circuits operate in two phases—the "set" phase, when the cores are switched into one state or the other, "0" or "1," by the input signals, and the "shift" phase, when the information on this state is made to appear at the output. The action is of necessity slower than the diode logical circuits, where all the switching occurs instantaneously, and in any case it is limited by the time-constant of the windings and magnetic core, which normally only allow operation at p.r.fs up to about 100kc/s. Hence the slower calculating speed of this machine compared with the Ferranti computer.

In spite of this inherent speed limitation the magnetic-core/transistor combination is likely to prove very popular as a circuit element in digital computers. The magnetic cores, as well as being small and robust, have a life which is probably infinite for all practical purposes, and while they are holding binary information by one state of remanent magnetization or the other they are not consuming power. Since they are inherently slow it is possible to use relatively inexpensive a.f. transistors for switching them, and in the National-Elliott 802 machine the ubiquitous OC72 performs this function. A basic computing element of magnetic core, transistor and one resistor mounted on a printed circuit is illustrated on page 18.

The speed of operation of magnetic-core/transistor computing circuits can be increased by working in the parallel mode instead of the serial mode. This means that all the digits of, say, a 32-digit number appear as pulses or spaces on 32 wires simultaneously, instead of in a time sequence on just one wire. Such a technique has been adopted in the Emidec 1100 digital computer shown by E.M.I. Electronics, a somewhat larger machine than those mentioned previously. The computer uses magnetic cores in combination with OC72 a.f. transistors and OC41, 42 and 45 high-frequency types. It has a high-speed "immediate access" magnetic-core matrix store (1,024 words capacity) driven by OC23 transistors, together with supplementary magnetic-drum stores each holding 16,384 words. These drums "write" and "read" digital information in sequential form, so special "serializer" and "parallelizer" circuits have to be placed between them and the parallel computing circuits. The word length, incidentally, is 36 binary digits, and numbers are transferred to and from the electromechanical input and output units in 6 lots of 6 binary digits. Instructions are of the two-address type.

Although the basic pulse rate of the Emidec 1100 is even lower than that of the National-Elliott 802 (actually 112kc/s) the speed of computing, owing to the parallel mode of operation, is a good deal

Creed high-speed paper tape punch.



Xerographic high-speed output printer made by Rank Precision Industries. The electronic equipment is housed in a separate cabinet.

faster. Addition, subtraction and other similar operations take about 120μsec, in fact. This speed is necessary, however, where it is not in the National-Elliott, because the Emidec is intended for entirely different applications. Moreover, the speed has to be paid for in the greater complexity of equipment necessary with parallel operation. The size of the Emidec machine is considerably smaller than that of equivalent valve machines and the power consumption of the computer proper is only 2kW—incidentally, it runs off car batteries!

E.M.I. Electronics were also showing a very much faster machine, the Emidec 2400, which uses diodes and h.f. transistors for the logical circuits and operates at the high pulse rate of 1Mc/s Magnetic cores are only present in the matrix store. Another, somewhat uncommon, quick-access store in the machine (64 words capacity) is formed by combinations of capacitors and diodes. Again, instructions are of the two-address type and the machine operates in the parallel mode. But the average time for addition and similar operations in this computer is only 0.6μsec—about 200 times faster than the Emidec magnetic-core/transistor machine.

Such high speeds of operation are now becoming quite common in digital computers. They have raised the very difficult problem, which is always being quoted nowadays, that the electro-mechanical output equipment cannot keep up with the electronic speed of the computing circuits and is, in fact, causing a "bottleneck" in the production of computed results. Output equipment usually consists of card punches, paper tape punches, line-at-a-time printers, or electric typewriters, and in practice various combinations of these are used.

Great efforts are being made to remove the "bottleneck" by developing existing types of equipment and inventing new kinds. At the Exhibition one of the most outstanding examples of development in existing methods was the Creed 3000 high-speed paper tape punch. This operates at 300 characters a second (a character being a row of holes across the tape), which is about ten times as fast as most of the tape punches currently available. To achieve such a high speed, start-stop operation has been confined to very light parts, the movements of which have been kept very small. Heavier components are arranged to have continuous smooth motions. Higher grade materials are used, tolerances are closer and the lubrication has been improved over previous machines.

Amongst the more unconventional output devices, a machine which is beginning to establish itself very firmly is the Powers-Samas "Samastronic" page printer. This has abandoned the conventional method of printing from type founts and uses reciprocating styli to build up the letters and figures from patterns of inked dots. As a result it can print on a page at the rate of 300 lines per minute with 140 characters in each line—compared with the 100 lines a minute or so of some of the more conventional page printers. A storage system holds the necessary information for constructing 50 different characters and these are called up automatically by code signals fed in from punched cards.

Probably the most spectacular of the high-speed computer output devices on show was the "Xeronic" page printer demonstrated by Rank Precision Industries (see picture). This dispenses altogether with mechanical methods of making marks on paper, but records photographically, by the dry xerographic process, characters "written" on the screen of a c.r. tube. It can print at the staggeringly high speed of 1,500 lines a minute with 128 characters in each line on 13-inch wide paper, and is being developed to work up to 3,000 lines a minute.

The machine is a combination of an existing xerographic copying machine called the "Copyflo" (made by Rank-Xerox, Ltd.) and an electronic

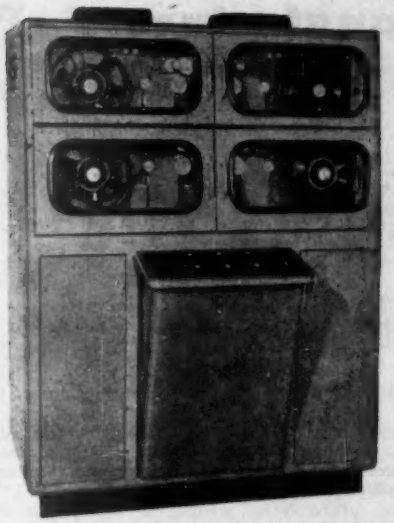
High-speed endless-loop magnetic-tape unit demonstrated by S.T.C. Three tape magazines are shown in the frame but five can be fitted.

character-generating equipment which is housed in a separate cabinet (except for the c.r. tube). Special c.r. tubes have been developed in the U.S.A. which form characters by passing the electron beam through "stencils" and focusing the resulting patterns on to the screen, but these are rather expensive items. The interesting point about the Xeronic machine is that it uses a normal instrument-type c.r. tube and the characters are formed rather like Lissajous figures by applying deflection signals to the X and Y plates. These deflection signals are produced by applying suitable waveforms to passive networks, and the results displayed on the screen (capital letters) are of excellent quality and clarity.

Other electronic circuits are used to decode the binary input signals which specify the required characters and also to decode input instructions relating to the layout of the printed data. These layout instructions include such functions as horizontal and vertical tabulation, line feed (equivalent to carriage return on a typewriter), spacing and stopping, and selection of forms and headings as may be required for bills, invoices and so on. Tabulation can be pre-set manually by a plug-board, while the size of the characters printed can be varied by adjusting the gain controls of the deflection amplifiers. Transistors are used extensively throughout the machine.

The actual xerographic process of recording the characters displayed on the c.r. tube is centred around a large rotating drum with a coating of selenium. To begin with the drum surface receives an electrostatic charge from a wire grid, and this is retained as long as the drum is in darkness. Next the images from the c.r.t. are focused on the drum, and these modify the charge on the selenium to form a charge pattern corresponding to the characters displayed. The resultant electrostatic image is "developed" by showering over the drum thermo-plastic powder which has been charged oppositely to the pattern of characters on the selenium so that it adheres to the electrostatic image. After this the powder image is transferred by application of another electrostatic charge to the band of 13-inch paper, which is in continuous contact with the face of the drum and moving at the same speed. Finally the powder image is fused permanently to the paper by passing under a heating element. At the end of the process the drum is cleaned and is then ready for further recording action.

Control desk of the Solartron ERA character recognizer, which reads documents such as till rolls at up to 300 characters/sec. (See "Wireless World," April, 1957).



Decca magnetic-tape storage equipment using two ½-inch tapes running at 100 inches/sec. The capacity is 23 million binary digits on each 2,400-ft tape.

At the Exhibition the Xeronic printer was shown operating from an input from a high speed endless-loop tape machine displayed by S.T.C. This machine runs at 100 inches per second and information is stored in blocks in several parallel tracks at a packing density of 250 binary digits to the inch. In this application each block (containing a maximum of 500 binary digits) was transferred serially to a "staticizer" or static store, after which each character of 5 binary digits was transmitted in parallel form over a 5-wire line to the printer. The tape transport mechanism was automatically controlled by the paper feed of the Xeronic machine.

Speeds of 100 inches/sec are now quite common for magnetic tape storage systems. One machine displayed by E.M.I. Electronics runs at 200 inches/sec, stops and starts in less than 5 milliseconds and reverses in less than 7 milliseconds. This rapid type of operation is necessary to reduce the access time to information which, by the very nature of magnetic tape, has to be stored in sequential fashion. Most of the machines developed recently have two driving capstans rotating continuously in opposite directions and the tape is "sucked" rapidly into contact with either one or the other by a vacuum system under the control of switching signals from the computer. Two tape loops or "reservoirs" between the capstans and the spools isolate the tape drive from the inertia of the heavy spools, and the "reservoirs" are kept filled with constant lengths of tape by a servo system controlling the spool drive motors. To avoid wear the tape runs out of contact with the reading/writing heads.

Manufacturers' Products

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Insulated Crocodile Clip

A PLASTIC crocodile clip with a completely insulated brass insert forming a serrated wire grip in the jaws and terminating at the rear of the clip in a socket for a single-stem cable plug is obtainable from Creators, Ltd., Sheerwater, Woking, Surrey. Made of polystyrene it measures 2in long, costs 1s and is available in either red or black plastic.

Insulated crocodile clip with socket for a plug (Creators, Ltd.).

Joint Service Component Specifications

IT is a requirement that all electronic equipment destined for Service use shall employ only type-approved components. What is an approved type is not always easy to decide although official documents such as the DEF5000 series of joint Service type-approved component specifications, and the earlier issues of the Radio Components Standardization Committee, do give the answers if one has the time and patience to delve deep enough into them.

A short cut to the essential facts required by design engineers of Service types of electronic equipment is now provided by a series of abridged joint Service approved component data sheets obtainable from H. W. Davies, Ltd., 1, Newman Road, Bromley, Kent. They are compiled by Electronic Technical Services (E.T.S.), an associated company, with the permission of H.M.S.O., because the E.T.S. series is derived from the official DEF5000 series of component specifications and the various documents issued by the R.C.S.C.

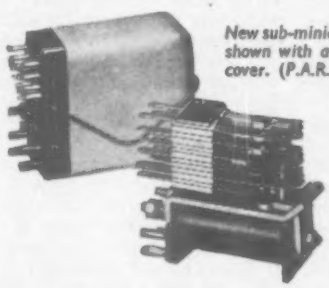
E.T.S. data are presented in a clear and concise manner and up to the present time some 500 loose-leaf data sheets have been issued. They are enclosed in a sturdy loose-leaf binder, well indexed for quick reference and the complete set of data sheets costs £15 15s 0d. When amendments are made to the official parent specifications new E.T.S. sheets are issued to replace the original or earlier ones and the familiar practice of having a lot of separate amendment slips to cope with is avoided.

An additional £1 11s 0d is charged to cover amendment sheets issued to date and there is a fee of about 30s per annum to cover the supply of future amendments.

Complete set of E.T.S. joint Service approved component specifications. Shown also is a specimen data sheet.

Sub-miniature "3000"-type Relay

A NEW Mark III version of the tiny P3 relay, which is a sub-miniature version of the well-known G.P.O. "3000"-type, has been introduced by P.A.R., Ltd., of Nottingham and obtainable from the distributors, D. Robinson and Company, 717, London Road, Hounslow, Middlesex.



New sub-miniature P3 relay shown with and without a cover. (P.A.R. Ltd.)

The new P3 can now be obtained fitted with heavy duty contacts rated at 5A at 240V a.c. or 24V d.c. The action can be make or break and moderately heavy inductive loads can be switched. Alternative contacts can be fitted for high-duty change-over action, with make before break if required. It seems to be a useful general-purpose relay of the right size for miniaturized equipment.

Up to six sets of contacts of mixed type can be fitted and a special feature of the design is that it is suitable for mounting on printed circuit boards.

The operating coil can be wound to have any resistance up to 9,000Ω, single or double wound, or slugged, and it requires as little as $\frac{1}{10}$ watt to operate it with one "make" contact only and about $1\frac{1}{2}$ watts for six sets of change-over contacts. With the maximum number of contacts the overall dimensions come within 1.7 × 1.5 × 0.765in.

110° SCANNING

SHORT C.R. TUBES BRING NEW PROBLEMS IN TELEVISION SET DESIGN

The Pye PV110 17-inch transportable receiver with 110° cathode-ray tube.

THE first of the long-awaited 110° television sets has now arrived on the British market—a 17-inch transportable made by Pye. As can be seen from the illustrations, the use of a 110° c.r. tube achieves a considerable reduction in cabinet depth, and in fact this dimension is only 13¾ inches overall (the height being 15 inches and width 17½ inches).

In general the 17-inch tube with a 110° deflection angle is about 3 inches shorter than the equivalent tube with a 90° angle. This particular c.r.t. is the C17/6A made by Cathodeon, a subsidiary of Pye. It has a rectangular screen of 5:4 aspect ratio (slightly increasing the picture area over 4:3 tubes but cutting the picture sides a little) and a narrow neck of 1¼in diameter which makes possible the greater deflection sensitivity required to scan the 110° angle. The electron gun is a tetrode type with an electrostatic focusing electrode, and the final anode operates at 16 kV. It is a straight gun and no ion trap is required. At present the 6.3V tube heater takes a current of 0.6A, which means that it cannot be included in the series heater chain and a special transformer has to be provided. In later models of the set a series-heater tube will be used.

Conforming to the modern tendency with transportable receivers, the cabinet plays a very minor role in the construction of the set. It is merely a decorative cover enclosing the metal frame into which the set is built. A moulded plastic mask-cum-filter-screen covers the front of the tube, giving protection and improving the picture contrast when room lighting is on.

The two main problems in the design of such 110° receivers are (a) obtaining sufficient scanning power to deflect the c.r.t. electron beam through the wider angle, and (b) getting the circuitry into the reduced space resulting from the use of the shorter tube. Taking the electrical problem (a) first, this is a matter necessitating very careful design of the line and frame output stages, transformers and deflection coils. A PL81 valve is used for the line output and a PL84 for the frame output. Several improvements in the line output transformer are obtained by a technique known as "d.c. cancellation" applied to the ferrite core. The direct-current anode supply to the line output valve passes through a section of the transformer winding in the normal manner but it also has to pass through another section of winding in the opposite direction. The magnetic fields produced by the d.c. in the two sections therefore tend to cancel, and this reduces the magnetic loading on the core.

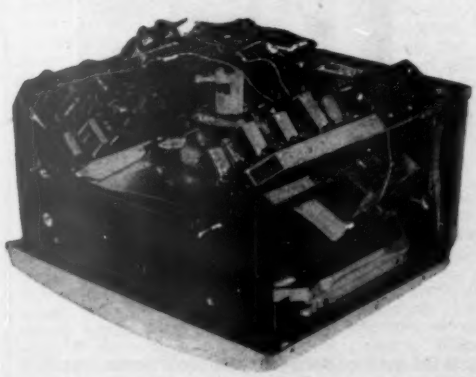
Apart from slightly increasing the transformer efficiency, this technique largely eliminates the time-base whistle which would otherwise be extremely annoying in such a high power scanning system. The transformer leakage inductance is tuned on the "third harmonic" principle,* which, as well as mitigating line scan ringing, reduces the peak voltage on the line output valve and PY81 efficiency diode and so leads to higher efficiency by allowing higher turns ratios.

The anode load of the PL81 line output valve is arranged so that the anode is driven hard into the "knee" of the anode voltage current characteristic. This, in conjunction with a carefully chosen screen grid resistor, makes the scan amplitude largely independent of the valve's characteristics. Moreover the amplitude does not change appreciably with reasonable mains voltage variations. There is no line scan amplitude control as this is considered a source of wastage of scan power.

In the frame scan output stage improved efficiency in the output transformer is obtained by the use of a grain-oriented low-loss steel for the cored laminations (called "Unisil" and made by The Steel Company of Wales).

The deflector coil assembly is characterised by a pronounced flare at one end of the windings, which

Back view of the Pye receiver with cabinet removed, showing how the tuner unit is mounted and the easy accessibility to the printed circuit boards.



* See "Overcoming Line Scan Ringing." By K. G. Beauchamp. *Wireless World*, September, 1957.

The incremental inductance tuner of the Pye set, with cover removed to show the small switch wafers with coils mounted on them.

allows the coils to extend a good distance up the cone of the tube. This is done so that the centre of deflection of the assembly can be as close to the screen as is necessary to avoid interruption of the beam by the end of the tube neck at the extremities of the 110° scan. Another reason for extending the windings as far as possible up the cone is to lengthen the distance in which the electron beam is affected by the magnetic field and so reduce the scanning current requirements. The coils extend as far back in the other direction as is practicable in a short-neck tube, and even overlap the final anode cylinder slightly.

The so-called "cosine" distribution of winding cross-section is used on the deflection coils to give uniformity of focusing all over the screen (which, of course, is particularly difficult to obtain with large deflection angles). This technique is well known for producing slight concavities in the sides of the raster ("pincushion" distortion) but correction is applied by small permanent magnets attached to the assembly. Toroidal frame coils are used, and thermistors are connected in series and incorporated in the assembly to correct the resistance changes caused by heating which would otherwise affect the picture height.

On the question of mechanical design, the main problem, as mentioned earlier, has been to find sufficient space for the circuitry around the short neck of the tube. Transistors are the obvious answer but this is a thing for the future. Meanwhile Pye's have worked out a neat form of construction based on two vertical printed-circuit panels on each side of the neck. When the cover is removed from the set both sides of these can be reached easily for servicing purposes. Power and e.h.t. supplies are arranged separately at the bottom of the chassis.

One of the largest circuit sub-assemblies in any television set is the tuner unit. Here the designers have saved a great deal of space by introducing a new miniature incremental inductance tuner (made by H.D.F., Ltd., of Lowestoft) which measures only $3\frac{1}{2}$in × $2\frac{1}{2}$in × $2\frac{1}{2}$in. It is situated between the back of the signal-frequency printed circuit and the tube cone. The four rotating coil switching wafers are of small diameter (actually $1\frac{1}{4}$in) and the coils are mounted on them and rotate with them (as distinct from previous Pye incremental inductance tuners in which the coils were connected to the fixed contacts of conventional wafer switches). Some of the Band-III inductance increments are just formed by conductors joining the switch contacts and are fabricated by printed circuit technique. The tuner circuit is the widely accepted arrangement of PCC84 cascode r.f. amplifier and PCF80 mixer/oscillator.

Audio-Frequency Spectrometer

THE Danish Brüel and Kjær Type 2110 uses 30 filters to divide the frequency range from 35c/s to 35,000c/s into $\frac{1}{3}$-octave bands. The rejection an octave away from the centre frequency is 52dB for those bands with centre frequencies between 160c/s and 16kc/s, and at least 36dB for the other bands. By paralleling the filter inputs and pre-loading their outputs so that there is no significent change in loading when the output amplifier is switched in, the filter ringing time can be made short enough to allow the input amplitudes in all the 30 pass bands to be recorded in 20 seconds. The total gain of the input and output amplifiers can be varied in 10dB steps up to a maximum of 100dB, and no attenuation is produced by the filters in their pass band. Four alternative standard frequency-weighting networks are available, and the instrument can also be operated as an amplifier with a response flat within ±0.5dB from 2c/s to 35,000c/s. The maximum sensitivity is 100μV input at high impedance for a full-scale meter deflection, amplifier noise corresponding to an input of 15μV (open circuited) under these conditions. The sensitivity can be checked using a built-in reference voltage. The peak, arithmetical mean, or r.m.s. value of the input signal can be measured; the r.m.s. error being kept to within 0.5dB for signals with crest values up to 5 by approximating the required square-law curve with straight-line portions. Other facilities include a polarizing potential variable between 150 and 250V for condenser incrophone inputs, and an output with an impedance of less than 50Ω for feeding a recorder. In this country the instrument is available from B. & K. Laboratories, Ltd., at 4, Tilney Street, Park Lane, London, W.1., and costs £426 10s.

Brüel and Kjær audio-frequency spectrometer Type 2110.

"BELLING-LEE" NOTES

The First of a new Series

CONTACTS

We set out to write something which we hope will be informative to many and perhaps act as a refresher to those who might consider themselves more profound.

Our chosen subject—contact resistance as applied to those components which we manufacture in vast numbers, terminals, plugs sockets, etc.

Within an hour we found that many books had been written on the subject, big fat tomes full of formulae, and we nearly gave up. But surely we can put on paper an essay of a few hundred words to remind ourselves and others of the various factors that are involved.

First of all, just what is a contact? It would appear to be a series of points of contact rather than an area. If we examine a flat surface under a microscope it looks like a ploughed field, infinitesimal scratches caused by rollers or cutting tools being the furrows. The ridges form the high spots and here and there the high spots are higher, therefore if two such surfaces are placed face to face, contact will be "here and there," only the highest spots touch, theoretically a minimum of three. If the two surfaces are ground and polished, it only requires a higher magnification to confirm this.

Fig. 1

Fig. 2

Figure 1 is intended to indicate a block of metal resting upon another. The contact surface is *not* the area of the adjacent faces, but contact will probably be made as shown in Figure 2, at about three points. It is not generally appreciated that when two pieces of metal touch—even lightly—the physical distortion caused by the breaking down of these points, generates heat and constitutes a minute hot weld, which is in fact broken when the two pieces are drawn apart.

Let us be quite clear about this, the condition exists between the coins in your pocket, and the heat so generated is measurable. In fact the friction between sliding solids is considered to be largely due to the breaking down of these minute welds. If sufficient pressure is applied to distort some of the higher points, then more points will touch and a better contact will result. Figure 3 shows the same theory applied to a plug and socket. Even if the plug is a tight fit in a socket, contact may only be made through a few high points. But the mass of metal around the contact points is important as it carries away the heat.

Fig. 3

The resistance at the point of contact depends upon the conductivity of the materials, and the cleanliness of the surfaces, i.e., absence of oxides, sulphides or other corrosions. That is why a wiping surface is desirable in switchwork. If the resistance at the point of contact is high, and if current is passing, heat will be generated and the higher the resistance the greater will be the heat. At this point it is worth a word of warning not to get involved with the current carrying capacity of the connector; this is another question to be dealt with later. Local heating of a resilient contact spring might cause annealing and loss of springiness, may be more heat, and any appreciable rise in temperature at the point of contact will tend to increase the formation of oxides, but this will not be very important once contact has been made. Where resilience exists, such as with a plug or socket, the normal operation ensures a wiping action which cleans such deposits.

Phosphor bronze is a good spring material of fairly high conductivity, but in its natural state is apt to form a bad conducting surface. The silver-plating of contact surfaces is favoured because silver is a highly conductive material, and the normal tarnish of silver is not an oxide but a sulphide, and is conductive But badly tarnished silver can be difficult to solder with fluxes that are safe to use. Where components designed to carry very small currents are expected to have an indefinite or very long "shelf-life," gold is plated on top of the silver, not because of better conductivity but because of its ability to withstand corrosion. It is interesting to remember here that with a very thin deposit of gold (known as a flash and may be only a micron (0.00004in.) thick) there will be "migration" of corrosive agents through the gold to the silver and the gold will appear to vanish in a comparatively short time. The gold deposit must be substantial and of the order of 0/.0002 or 0/.0003ins., if a long life is required.

Most high conductivity materials are soft, therefore silver or gold is often plated onto harder metals; beryllium copper is the exception, it is frequently used for sockets because it can be hardened and is ideal for the purpose; it is not essential to plate it but we do offer sockets in this material silver or gold plated. Where a gold or silver plated plug is being plugged into a beryllium copper socket, great care must be taken to ensure that the socket is free from burrs which would quickly scrape away the softer material. This would result in impaired contact, to say nothing of the possibility of metallic particles finding their way where they are not wanted.

"BELLING-LEE" MINIATURE COAXIAL UNITORS

ACTUAL SIZE

The Domino with a difference

These Unitors are designed to be used in conjunction with our series of 'Domino' Unitors, and may be mounted with them in two- or three-way shrouds.

Each Unitor carries two miniature coaxial connectors which are of similar design to the plug and free socket of the L.1417 series and can be interconnected with them.

The brass shrouds (L.1404, L.1405 and L.1406) for mounting one, two or three Unitors, are each available for either flush or surface mounting.

Each Unitor is polarised by means of a flat on the locating spigot, so that the two coaxial ways cannot be accidentally interchanged.

ELECTRICAL DATA

D.C. breakdown voltage at these pressures:

Atmospheric	70 mm mercury	10 mm. mercury	2 mm. mercury
3750 V	1000 V	500 V	460 V

These figures relate to the voltage between the two-way shroud (L.1405) and one outer conductor. The Unitor was not loaded with cable.

Most "Belling-Lee" products are covered by patents or registered designs, or applications therefor.

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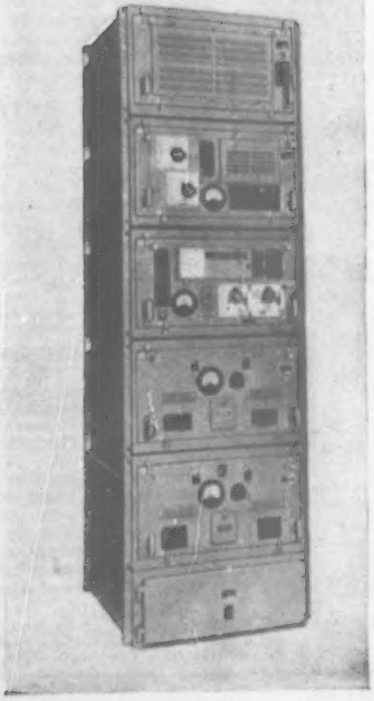

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What Makes Currents Flow?

Divertissement on an Original Theme by G. S. Ohm

By "CATHODE RAY"

AFTER a whole year of grinding through atomic theory, wave mechanics, Pauli exclusion, Heisenberg uncertainty, Fermi levels, phase and group velocity, dispersion, etc., regular readers (if any are left) will be thinking that if even Christmas brings no let-up the last hope of a return to the good old days when "Cathode Ray" stood for the simple things of life will have to be abandoned. Well, here we have a nice seasonable question, almost fit for a quiz game during the period of intellectual torpor following the Christmas dinner. I promise to make allowances for such circumstances, by discussing the matter in terms which at other seasons might be considered an insult to the intelligence.

So, for a start, let us understand that the currents in question are electric currents. And we won't bother much about the details of what electric currents are, or even whisper the word "hole," but will just regard an electric current as a movement of electric charges.

Until quite recently I wouldn't have thought that the title question would provide enough material for even a Christmas-length article. Surely a current is driven by an e.m.f.? The very name—electromotive force—signifies that. If pressed, one might admit that an alternative and perhaps more strictly correct answer would be "an electric field." But wouldn't that be a bit of a quibble—like insisting that a Christmas balloon was not burst by the pressure but by the pressure per square inch? One would know what to do with anyone who took that sort of line at a party—and I don't mean political party.

The reason for the matter cropping up now is that recently more than one learned authority has at least given the impression that currents are driven by electric charges. K. C. Johnson, for example, on p.429 of last September issue wrote that the properties of semiconductors "are most easily understood by considering the electric fields applied, and the densities of mobile charges present as causes, and the currents that flow as an effect." It is true that electric fields are named first among the causes, and earlier he said outright that "electric fields make mobile charges move." Are "the densities of mobile charges" an alternative cause, or what?

Then P. Hammond chose the exalted medium of an I.E.E. Monograph (No. 286, on "Electromagnetic Energy Transfer") in which to make quite an issue of the importance of electric charges, alleging that their role in electrical engineering was commonly ignored. Discussing Ohm's law, he pointed out a difficulty. "What is the origin of the electric force E on the current in the wire at a place considerably distant from the terminals of the battery? Clearly E can arise only from electric charges." By "electric force E" Mr. Hammond does not mean electromotive force, which unfortunately is also denoted by E, but electric field strength. This, of course, is reckoned in volts per metre, whereas e.m.f. is just volts.

If Mr. Hammond will forgive my saying so, experience has taught me to beware of the word "clearly." Too often it is used to pull a fast one. I don't suggest that that was the intention in this case, but I for one am not at all clear whether the statement so prefixed was meant to be universal, or confined to the particular circuit under discussion (a wire connected to the terminals of a battery). Farther on, with reference to the same circuit, we read that Ohm failed to see that a charge "provided the source of the necessary electric force"; and "only a minute amount of charge is required to cause the current to flow. Nevertheless, a total absence of electric charge would also mean the cessation of current flow. The necessity for this charge distribution is hardly ever mentioned in the textbooks." And elsewhere* "the existence of a charge distribution to drive the current, which was recognized by Ohm, is almost always ignored.

I found all this rather disturbing, for it seemed to mean that electric currents were not driven, as I had supposed, by e.m.fs but by electric charges.

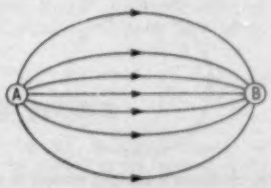


Fig. 1. If electrons are transferred from A to B, A becomes positively charged, B negatively charged, and the resulting electric field is conventionally represented by the lines of force as shown.

Since early youth I had believed that electric currents and the separation of electric charges were both due to e.m.fs. Nor had I been conscious that the charges were being ignored. For all I know they may be ignored in books about d.c. and 50-c/s electrical machinery, where the presence of charges is generally of only academic interest, but they certainly are not and cannot be in (for example) *Wireless World*.

But that is by the way. The question is "What makes (electric) currents flow?"

If you take a quantity of electrons from a place A (Fig. 1) and dump them at another place B, then the surplus of electrons at B constitutes what we call a negative electric charge. The atoms which were robbed to provide those electrons are no longer electrically neutral; their unbalanced protons are a positive charge. A mechanical force of attraction appears between these opposite charges at A and B, and (to conceal our ignorance) we say that there is an electric field in the space between. This is shown in the usual way by drawing a number of thin lines between A and B, with arrow heads pointing from + to −. Let us assume that A and B are well insulated from one another, for otherwise the attraction would soon pull the electrons back to A and

*Journal I.E.E., June 1958, p. 296.

restore the original uncharged or neutral state. I say electrons, because the positive charges at A are parts of the atoms themselves and cannot normally move unless A moves as a whole. Even that could happen if it were free to move; for example, if A and B were charged objects floating on a pool of oil, for they would be drawn towards one another like magnets. But let us assume that A and B are fixed.

However, there might be a few stray charges in the space; electrons, say. Being negative they would be repelled from B and attracted to A. The direction along which this force acts on them is the direction in which a line of force passing through that point would have to be drawn to make the diagram correct. In other words, the lines of force show the directions along which small free positive charges would be pulled by the field. (Electrons, being negative, move along the same line in the opposite direction.) Incidentally, don't fall into the trap of thinking that a free electron would actually follow its line of force all the way to A. On a curved line

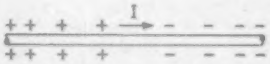


Fig. 2. When a current I is driven along a wire, charges become distributed along it as roughly shown here.

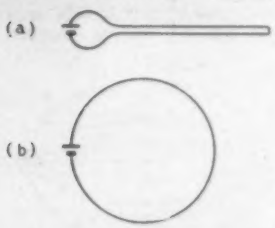


Fig. 3. The amounts of charge distributed depend very largely on the shape of the circuit; in (a) for example they would be far more than in (b).

the electron's inertia makes it swing out, like a stone pulled along a sheet of ice by a string held by a boy running in a curved path. The direction in which it moves is not always the same as the direction in which it is being pulled, as shown by the string or the line of force.

Since an electric current consists of electric charges in motion, one could say that a current was being caused in the space between A and B by the electric field (or force) there. And because the electric field is in this case caused by the charges at A and B, one could say (and presumably Messrs. Johnson and Hammond do say) that the current was being caused by those charges. But since that is a cause once removed they could hardly object if I were to look at the cause twice removed and say the current was being caused by whatever it was that created those charges by moving electrons from A to B. The usual "whatever it was" is, of course, an e.m.f. You yourself even might claim to be the cause, as the switcher-on of the e.m.f. And so on.

This is developing into something very like those lengthy arguments (now for the season in abeyance) put forward by expensive legal gentlemen in the High Courts: was the regretted death of Mr. X in a motor accident caused by the neglect of Mr. Y, the mechanic who forgot to replace the nut on the steering gear, or by Mr. Z, his employer, for engaging such a clot? But seeing that in our case there are no damages to pay (unless Johnson or Hammond sue me for libel), wouldn't it be best to decide that the cause of electric currents is just a matter of opinion, according to the way of looking at it? Then Johnson is right, Hammond is right, I'm right, you're right, everybody is right, so all will have prizes as in a caucus race.

Well, I'm awfully sorry to stop such a delightful solution being carried unanimously, but if we are to understand that there is always what the lawyers call an unbroken chain of causation from e.m.f. through charges and electric field to electric current, I must be a spoil-sport and object. Let us consider one of Mr. Hammond's own examples: a straight length of conductor — a piece of wire, say — as in Fig. 2, carrying current. Let us suppose the current is flowing from left to right, as shown. Then it is quite true, as he says, that there will be charges on the wire, the left hand being positive with regard to the right, and the density of the charges changing gradually, as I have tried to show. Mr. Hammond would, I think, say that these charges are needed to provide the uniform electric field to make the current flow along the uniformly resistant wire. I would say that there is an e.m.f. somewhere to make the current flow against the resistance of the wire, and it sets up a potential difference between the ends of the wire and (because the wire's resistance is uniformly distributed along it) between any two points along it. Now any two places between which there is a difference of potential must necessarily have become charged according to their capacitance, in accordance with the "Ohm's law of electrostatics":

$$Q = VC$$

where Q is the amount of charge, V the p.d. and C the capacitance.

Hammond—and apparently Johnson—find it helpful to look on the charge distributed along a wire or any circuit as the apportioner of the electric field strengths throughout its length so as to ensure (under d.c. conditions) the same current throughout. Mr. Hammond points out that the amount and distribution of the charge along a circuit varies drastically with the shape the circuit is bent into, all else including the strength of current being constant. Even this doesn't shake his faith in the idea of the two things being related as cause and effect, though he confesses to being amazed that the current should remain constant in spite of the extensive changes of charge. I (and I imagine most of you) are not amazed, because the resistance R (or conductance G) and the e.m.f. and p.d. are assumed to be unaffected by the bending about, so we expect

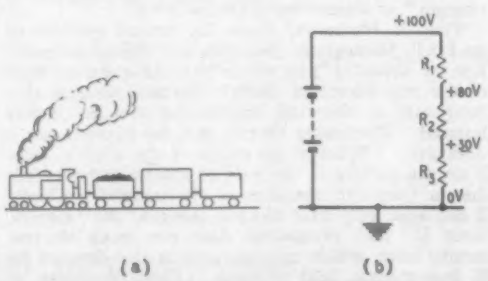


Fig. 4. A train (a) provides an interesting analogy with an electrical circuit (b).

Fig. 5. In the circuit formed by a wire ring around a core carrying a varying magnetic flux, a current flows without any difference of potential or accumulation of charge.

the current to remain constant in accordance with

$$I = VG$$

I have written G instead of the more familiar 1/R to help comparison with the previous equation. Both equations apply to the whole wire circuit or to any part of it. Both I and Q are directly proportional to V, but whereas I depends on G (which is not affected by the bending) Q depends on C (which is). *Wireless World* readers at least are familiar with the self-capacitance of circuits and would need no reminder that if the wire were arranged as in Fig. 3(a) it would have much greater capacitance and would therefore have much greater charges accumulated along it than if it were opened out as at (b). Surely it is more natural to regard Q as a parallel result of V than a cause of I?

We have seen that Johnson admits "electric fields applied" as causes of currents, and Hammond implies that there are causes other than charges when he goes on to consider the wire in Fig. 2 with a magnetic field sweeping past it, as in the usual sort of revolving-field power-station generator. There is then an induced "electric force" throughout the length of the wire, sufficient to overcome the small resistance to the flow of current and produce in addition a relatively large voltage between the ends of the wire, capable of making the same current flow through the resistance of an external circuit. To do this, the right-hand end must be positive. So the charge distribution must be of opposite sign to that shown in Fig. 2, and usually much more intense. If one were to consider the charges as the cause of the current flow one would expect it to flow in the opposite direction and be much stronger! Why, then, so much emphasis on them in the case of no induced e.m.f.? Surely it is not only unnatural but confusing to introduce the idea of charges causing currents?

We may find it instructive to join engine spotters by the side of the railway line and consider a short goods train as it passes; Fig. 4(a). The whole train is going at the same speed. What makes it go? Wouldn't you be surprised if one of your young companions replied "Each wagon is made to go by the stretching of the couplings between it and the rest of the train"?

Yet that seems a fair equivalent of the concept advocated by the writers quoted. Fig. 4(b) shows the electrical analogue: the whole circuit is the train, the resistors are the wagons, the e.m.f. of the battery is the motive force of the engine, the speed of the train is the current strength, the voltages at the circuit junctions are the tensions in the couplings, and the charges accumulated are the stretchings of those couplings. To my simple mind, the train and the current are made to go by the engine and the battery respectively (or their motive forces, if you want to be fussy).

The tension is greatest just behind the engine, and falls off to zero at the back end of the train. Similarly the voltages, marked at (b), decrease from a maximum at the battery end of the chain of resistors to zero at the earthed end. The speed of any one wagon depends on the difference between the tensions at its front and rear couplings, and on its frictional resistance; and of course the tensions throughout the train adjust themselves so that it all moves at the same speed. The couplings stretch to an extent depending on the tensions and their own compliances. Would anyone suggest that it is the stretching that makes the train go? Work out the analogy in Fig. 4(b)!

Reversing the battery reverses the signs of all the voltages and reversing the engine makes all the tensions negative, which means that they would be compressions.

The effect of an e.m.f. distributed along the circuit itself, as in the generator wire, is represented by running the train on a slope. It is then possible for the tensions in Fig. 4(a) to change to compressions, the trucks driving the engine against its brakes. (This may be contrary to good railway practice, but no matter!) With one particular gradient, and the right relationships between weight and friction of the wagons, it is possible for the train to be running along without coupling stresses or strains anywhere. Similarly (and this is the trump card) you can have current flowing in a circuit without any potential differences or accumlated charges. Fig. 5 depicts a uniform wire forming a closed circle around an iron core through which magnetic flux is changing at a uniform rate. A considerable current is likely to flow around the wire, but the whole circuit will be at the same potential, so there will be no surface charge redistribution.

What makes the current flow? Redistribution of charges? Or is it no accident if they are often ignored?

CLUB NEWS

Barnet.—R. G. Shears (G8KW), managing director of K. W. Electronics, will be the speaker at the meeting of the Barnet and District Radio Club at 8.0 on January 27th. Lecture meetings are held on the last Tuesday of each month at the Red Lion Hotel, High Barnet, and morse and instructional meetings on the second Tuesday at the A.T.C. Headquarters, Gloucester Road, New Barnet.

Bexleyheath.—At the January 22nd meeting of the North Kent Radio Society E. C. Hasted (G3BHF) will talk on power-pack design. Meetings are held fortnightly at 7.30 at the Congregational Hall, Bexleyheath.

Bradford.—Mobile operation will be dealt with by J. J. Platt (G2VO) at the January 13th meeting of the Bradford Amateur Radio Society. Meetings are held fortnightly at 7.30 at Cambridge House, Little Horton Lane, Bradford, 5.

Cleckheaton.—Bridge circuits will be discussed by S. Marsden at the meeting of the Spen Valley Amateur Radio Society on January 21st. The guest speaker at the Club's annual dinner on January 24th will be I. C. I. Lamb, engineer-in-charge of the I.T.A. station at Emley Moor.

Manchester.—A talk on the conversion of Government surplus equipment will be given to members of the South Manchester Radio Club by F. Nicholls (G3MAX) on January 9th. The club meets each Friday at 7.30 at Ladybarn House, 17, Mauldeth Road, Manchester, 20.

Prestatyn.—"Looking Back" is the title of the talk being given by F. G. Southworth (GW2CCU) at the January 8th meeting of the Flintshire Radio Society. The club meets on the first Monday of each month at 7.30 at the Railway Hotel.

South Kensington.—J. Lank, chief development officer of T.C.C., will speak on capacitor techniques and peculiarities at the January 5th meeting of the Civil Service Radio Society. The meeting will be held in the Science Museum Lecture Hall at 6.0.

Wellingborough.—"The lighter side of TV servicing" is the title of the talk being given by F. Wright, of Rushden, at the January 22nd meeting of the Wellingborough and District Radio and Television Society at 7.30 at Silver Street Club Room.

Automatic Error Correction

Repetition Methods in Multiplex Radio Teleprinters

By P. R. KELLER,* B.Sc., A.M.I.E.E. and L. K. WHEELER,† B.Sc.(Eng.), A.M.I.E.E.

No doubt readers will be generally familiar with the fact that a very large part of telegraph communication is effected by means of the teleprinter and that the mode of signalling is by a binary code, each character signal comprising five information units (giving 32 permutations) preceded by one unit that sets the printing receiver in operation, and succeeded by an element of one to one and a half units minimum duration to permit the receiver to come to rest. Thus synchronism has to be maintained only over the period of a character permutation, and the effect of speed differences between transmitter and receiver is not cumulative.

In certain instances communication by teleprinter over radio links can be successful during appreciable periods, but there are great variations in propagation characteristics and, although refinement in methods of signal modulation and detection (including diversity) may be employed to ameliorate these, there may be periods in which noise and fading still prevent reliable communication. In the event of falsified signal elements direct teleprinter operation suffers in two ways. It is obvious that if one or more of the five information units is incorrectly received a wrong character will be printed, since all the permutations are significant (i.e. there is no redundancy in the code). But, if the start or stop element is affected, the relative phase of the transmitter and receiver is upset and an error in one character can result in falsification of succeeding characters even though the elements of these are unmutilated in transmission. The second of these troubles can be overcome by using synchronous transmission (i.e. the telegraph transmitting and receiving apparatuses run continuously, instead of on a start-stop basis, and are closely controlled in speed and phase by special means). The effects of the first type of error still remain, however, and various ways have been used to minimize them.

* Marconi's Wireless Telegraph Co., Ltd.
† Post Office Research Station.

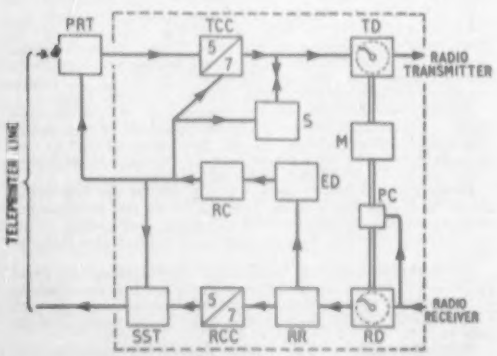


Fig. 1. Van Duuren system of error correction by automatic repetition.

Message Protection.—The simplest form of message protection is by multiple transmission (which could be called "time diversity") and comparison of the various received versions. Variations of this method, in which the signals of the multiple transmissions are automatically compared element by element and the most probable result accepted, have also been used, but it is obvious that these ways are very uneconomical in the exploitation of the transmission capacity.

The most usual method now employed, the application of which is steadily increasing, is the use of a protective or error-detecting code. The use of such a code alone, of course, indicates only that a mutilation has occurred during transmission, but it removes any misapprehension as to the accuracy of the received message, particularly when it is encoded in "secret language". (The use of error-detection to permit automatic correction is explained later.) The fundamental property is that the number of units in the code allows more permutations than are required for the number of information symbols to be conveyed (i.e. the code has redundancy). This permits the choice of permutations to represent symbols so that they have some common characteristic (e.g. the number of units of one kind in all used permutations can be made odd, even or the same). Hence, if a permutation without this predetermined characteristic is received, it is certainly an error. There is always, of course, some probability that compensating errors in the units will occur and cause "undetectable errors". This probability decreases as redundancy is increased with properly designed codes, but inevitably the number of detected errors will increase. "Self-correcting" codes are also known which enable wrong signal elements to be identified and reversed, but these require a greater measure of redundancy and are generally regarded as uneconomical for ordinary telegraph applications.

In the 1930s Moore and Mathes introduced for use with the R.C.A. synchronous multiplex system a 7-unit code in which each of the characters was represented by permutations comprising three marking and four spacing elements. This enabled errors to be indicated by a distinctive symbol on the record printed by special 7-unit printers. Van Duuren (of the Netherlands P.T.T.) adapted this basic code-form and extended its usefulness by reallocating the permutations amongst the information symbols so that an automatic translation from and to the International Alphabet No. 2, used for teleprinters, was facilitated. The teleprinter code has 32 permuta-

tions and the 7-unit protective code has 35 permutations available. Two of the excess permutations can be used for signalling the teleprinter line conditions of continuous mark, the condition during a pause in the message, and continuous space, which is used as a clearing signal in teleprinter exchange systems.

Error-correction by Automatic Repetition.—Van Duuren also conceived the idea of error-correction by repetition of the faulty permutation from the transmitter when an error is detected by the receiver. The basic outline of his "teleprinter over radio (TOR)" system, which provides a means for reliable communication between teleprinter systems over a radio circuit, is shown in Fig. 1. The teleprinter signals are received by a receiving reperforator-retransmitter (PRT) which records them on a perforated tape which is then read into the TOR at the correct time interval. The code signal is presented in parallel form to the code-converter (TCC) which comprises a relay switching system. The resultant 7-unit code permutations are transmitted sequentially by a mechanical distributor (TD) driven by a synchronous motor (M) fed from a stable-frequency source of power. The 7-unit permutations are also stored for a period (as will be explained later) as charges on a bank of capacitors, a series of banks (S) being switched in sequence by relays so that several characters may be stored.

The received signals are registered as groups of 7 units on relays (RR) via the receiving distributor (RD) which is driven from the synchronous motor (M) through a phase-correcting mechanism (PC) controlled by the signals. The register (RR) is connected to the receiving code converter (RCC) and also to the error-detector (ED) which is a form of Wheatstone bridge that is in balance if the received code permutation has the correct ratio of marking to spacing elements. If the signal is correct, the code-converter emits the corresponding 5-unit permutation to a start-stop transmitter (SST) that adds start and stop elements and sends the signal to the teleprinter.

If, however, the 7-unit combination is incorrect, the repetition control circuits (RC) stop the read-out to the teleprinter and the input from the tape reader. (It is not necessary for the teleprinter to stop sending as the perforated tape accommodates the overrun.) The error signal (which will be termed RQ), for which the 35th permutation is used, is sent back to the distant station followed in sequence by the symbols in the store. At the distant station the receipt of the RQ causes a similar train of events. (It will now be obvious that the number of symbols stored must be sufficient to cover the time for transmission in both directions plus the time taken to register a complete permutation.) The characters repeated from the store are transmitted, and, if the one previously faulty is now received satisfactorily, full communication in both directions is restored, but, if it is still incorrect the repetition cycle is repeated.

Multiplex operation.—Generally, it is possible to operate the radio channel at higher speeds than are required to accommodate one teleprinter channel, and time-division multiplexing is employed to cater for two or four teleprinter channels. The limit is set by multi-path effects on the radio link. The apparatus is usually built on a two-channel basis, symbols from channels A and B being transmitted alternately. The polarity of signals in one channel is inverted so that it is impossible to obtain through transmission unless the channels are phased correctly; this prevents the possibility of misrouting. Four-channel transmission is usually effected by combining two two-channel equipments so that the signal elements are interleaved in time, the element unit period being reduced to half the former value.

Standardization.—Other allocations of the 7-unit code have been devised with various advantages, but a modification of the original one is recommended by the C.C.I.T.T. which has also standardized the speed of operation. The code is shown in Table I and the speeds in Table II. (One baud is one elementary information unit per second.)

Improvement in Error Rate.—It is difficult to give a precise figure for the improvement in communication brought about by the introduction of automatic repetition on detection of error (ARQ)

TABLE I

FIGURES	LETTERS	INTERNATIONAL TELEGRAPH ALPHABET No.2	7-UNIT CODE
–	A	● ● ○ ○ ○	○ ○ ● ● ○ ● ○
?	B	● ○ ○ ● ●	○ ○ ● ● ○ ○ ●
:	C	○ ● ● ● ○	● ○ ○ ● ● ○ ○
	D	● ○ ○ ● ○	○ ○ ● ● ● ○ ○
3	E	● ○ ○ ○ ○	○ ● ● ● ○ ○ ○
½	F	● ○ ● ● ○	○ ○ ● ○ ○ ● ●
@	G	○ ● ○ ● ●	● ● ○ ○ ○ ○ ●
£	H	○ ○ ● ○ ●	● ○ ● ○ ○ ● ○
8	I	○ ● ● ○ ○	● ● ● ○ ○ ○ ○
BELL	J	● ● ○ ● ○	○ ● ○ ○ ○ ● ●
(	K	● ● ● ● ○	○ ○ ○ ● ○ ● ●
)	L	○ ● ○ ○ ●	● ● ○ ○ ○ ● ○
.	M	○ ○ ● ● ●	● ○ ● ○ ○ ○ ●
'	N	○ ○ ● ● ○	● ○ ● ● ● ○ ○
9	O	○ ○ ○ ● ●	● ○ ○ ○ ● ● ○
0	P	○ ● ● ○ ●	● ○ ○ ● ● ○ ○
1	Q	● ● ● ○ ●	○ ○ ○ ● ● ○ ●
4	R	○ ● ○ ● ○	● ● ○ ○ ● ○ ○
'	S	● ○ ● ○ ○	○ ● ○ ● ○ ● ○
5	T	○ ○ ○ ○ ●	● ○ ○ ○ ● ○ ●
7	U	● ● ● ○ ○	○ ● ● ○ ○ ○ ○
=	V	○ ● ● ● ●	● ○ ○ ● ○ ○ ●
2	W	● ● ○ ○ ●	○ ● ○ ○ ● ○ ●
/	X	● ○ ● ● ●	○ ○ ● ○ ● ● ○
6	Y	● ○ ● ○ ●	○ ○ ● ● ○ ○ ●
+	Z	● ○ ○ ○ ●	○ ● ● ○ ○ ○ ●
CARRIAGE RETURN		○ ○ ○ ● ○	● ○ ○ ○ ○ ● ●
LINE FEED		○ ● ○ ○ ○	● ○ ● ● ○ ○ ○
FIGURE SHIFT		● ● ○ ● ●	○ ● ○ ○ ● ● ○
LETTER SHIFT		● ● ● ● ●	○ ○ ○ ● ● ● ○
SPACE		○ ○ ● ○ ○	● ● ○ ● ○ ○ ○
UNPERFORATED TAPE		○ ○ ○ ○ ○	○ ○ ○ ○ ● ● ●
RQ SIGNAL			○ ● ● ● ○ ○ ○
α IDLE SIGNAL α			○ ● ○ ● ○ ○ ●
β IDLE SIGNAL β			○ ● ○ ● ○ ● ○

α CORRESPONDS TO CONTINUOUS START POLARITY (TELEX CLEARING SIGNAL).
β CORRESPONDS TO CONTINUOUS STOP POLARITY (TELEX CALLING SIGNAL)

TABLE II

Teleprinter Modulation Rate	7-unit Multiplex Modulation Rate	
	2-channel	4-channel
50 bauds	96 bauds	192 bauds
*45.45 bauds	85 5/7 bauds	171 3/7 bauds

* This is not part of the International Telegraph and Telephone Consultative Committee (C.C.I.T.T.) recommendation for operation on International circuits, but is proposed by the International Radio Consultative Committee (C.C.I.R.) for use when American speed is acceptable to both parties.

systems, because of the infinite variability of conditions encountered in transmission. However, in a circuit which without protection would produce one error per hundred characters printed it would not be unusual for the rate to be reduced to one per ten thousand characters printed. The operation of such a system, of course, necessitates a return circuit, and if this is similarly affected, the time taken to dispose of messages would be increased by about eight per cent in the above example; but, in the absence of automatic repetition, the additional load placed on the circuit and operators by messages of verification would render commercial operation impossible. It is particularly important in Telex services, in which the subscribers are in direct communication, for the printed copy to be as "clean" as possible, because there is no opportunity before delivery for scrutiny and clearing of obvious errors due to faulty transmission.

Electronic Equipment.—Following the success of the original electromechanical apparatus, engineers in several countries have considered the design of analogous electronic apparatus. One design, evolved by the Post Office Research Station, and revised in co-operation with Marconi's Wireless Telegraph Co., Ltd., has been engineered by this firm for production, and is being marketed under the name "Autoplex"†. Although it will be obvious to those familiar with electronic techniques that the functions of the various parts of the apparatus could be performed by a variety of different circuit elements, the above design will be briefly described as a typical electronic equipment.

† Regd. trade mark.

The simplified block diagram of an Autoplex two-channel time-division error-correcting terminal equipment is shown in Fig. 2. In this system the storage of transmitted characters precedes the coder, thus permitting the use of common translation equipment.

This equipment uses cold-cathode tubes for all frequency dividers, distributors, registers, storage and counting stages, but the block diagrams are appropriate to alternative circuit elements. Cold cathode tubes offer the advantages of low power consumption and heat dissipation (little or no standby power is required, according to type), long life, reliability, and visual indication of their on/off condition. The last advantage is an important point in servicing.

Timing Circuits.—Referring to Fig. 2, the transmitter and receiver element distributors are driven from a high-stability 9.6 kc/s crystal oscillator via ring-counter frequency dividers. By switch selection of the scale of division the equipment can operate at aggregate speeds of 85.5/7, 96 or 100 bauds.

The timing equipment is shown in more detail in

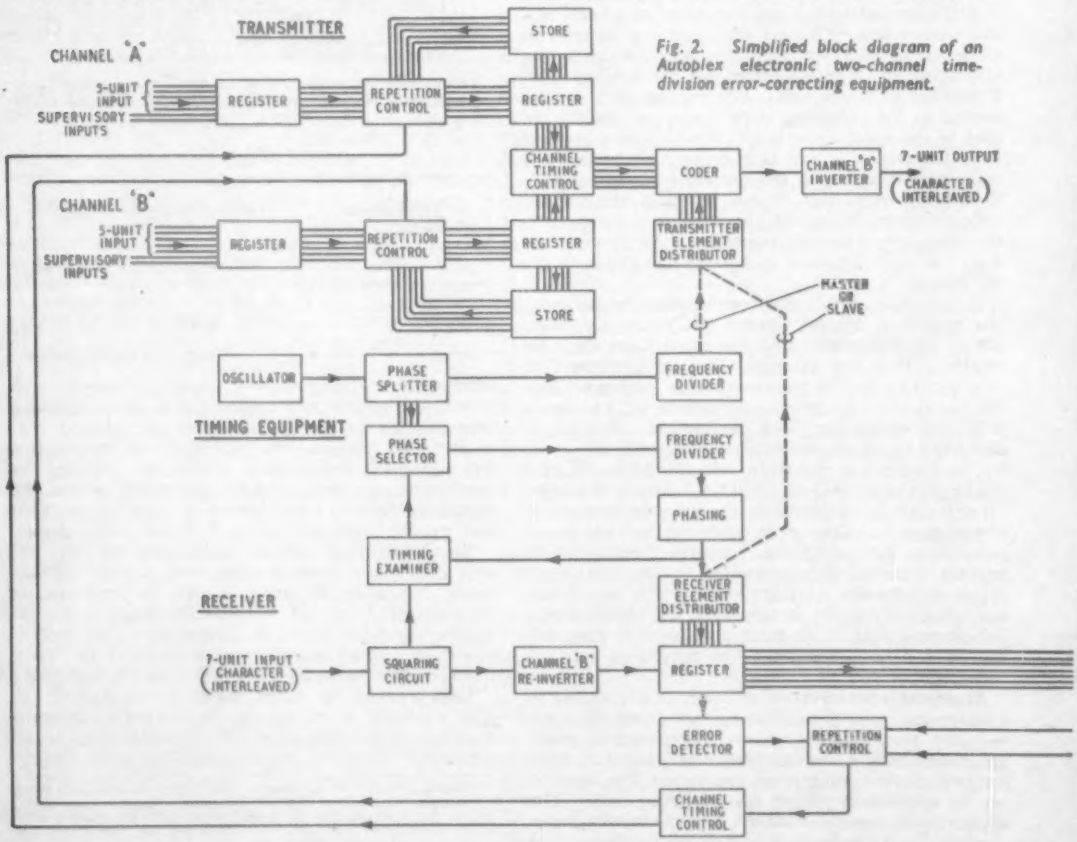


Fig. 2. Simplified block diagram of an Autoplex electronic two-channel time-division error-correcting equipment.

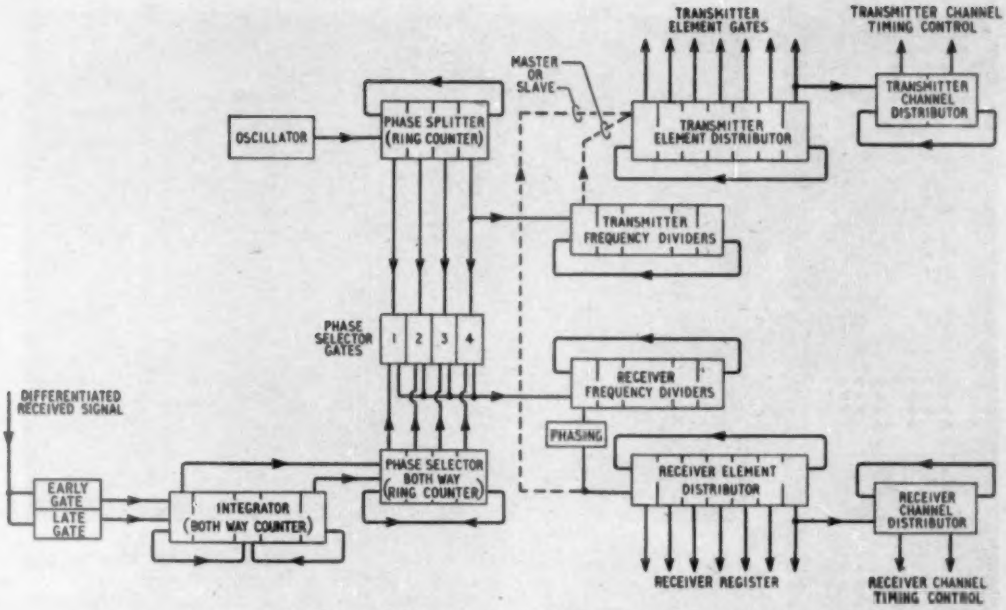
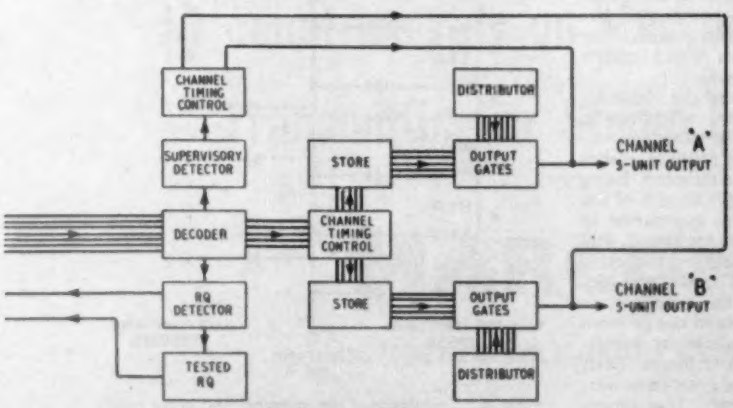
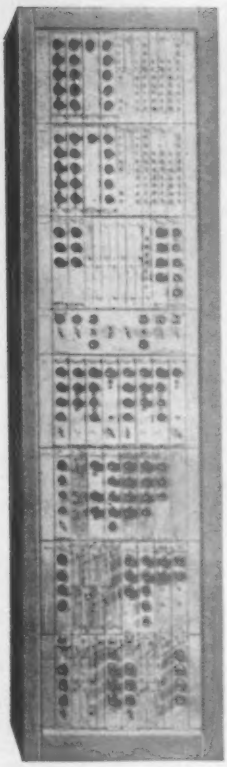


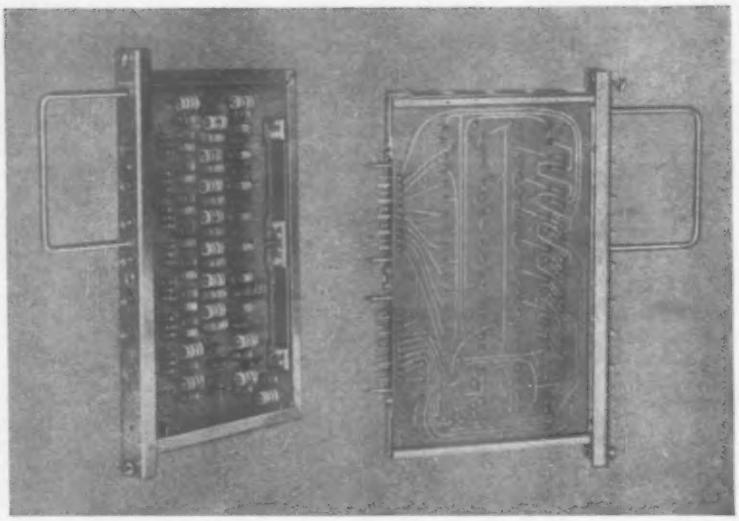
Fig. 3. Detailed block diagram of timing equipment in the Autoplex.

Fig. 3. Synchronism is achieved by applying continual correction to the timing of the receiver distributors, and at one terminal (the slave station) the transmitter element distributor is locked in a specific phase relationship to the receiver distributor. The timing examiner compares the relative timing of the transitions of the incoming aggregate signal with the drive pulses to the receiver element distributor. Early transitions step the phase selector counter to advance the phase of the drive to the receiver frequency divider via the phase selector gates. Late transitions cause the phase of the drive to the frequency dividers to be retarded. To prevent unnecessary changes of phase when the aggregate signal is time distorted due to multi-path propagation it is desirable to include an integrating device (both-way counter) so that the phase selector steps only when the number of early transitions exceeds the number of lates (or vice-versa) by a specific number.

Transmitter Circuits.—Referring to Fig. 2, 5-unit characters or supervisory signals to be transmitted over the system are registered at the inputs of the channels. Since 35 different signals have to be presented to the coder, and there are only 32 permutations in 5-unit code, the first register acts as a simple coder and provides a 6-wire output to a further register. In the 6-unit code a mark is added as the sixth element to normal characters, and supervisory signals are formed by permutations in which the sixth element is space. The channel timing control, driven by the transmitter channel distributor (see Fig. 3), causes characters from the two 6-unit registers to be passed in turn to the coder where the translation to 7-unit code is effected. As each character is transmitted over the system it is also passed to a shifting store which normally accommodates 3 characters, which are discarded in turn if a repetition is not required. In the Autoplex equipment the coder is of the decode-recode type, the first half breaking down the 6-wire input to the 35-wire form, and the second half forming the 7-wire output. This type of coder does not require that there be a logical relationship between the 5-unit and 7-unit codes. Servicing is simplified by the provision of test points at the 35-wire stage. A typical section of the coder (translation for character "A") is shown in Fig. 4. Five pairs of input terminals are provided,







Above: Typical unit of the Autoplex.

Left: The Autoplex electronic error-correcting equipment for teleprinters.

each pair indicating the condition of one of the elements of the 5-unit character. One terminal (the upper) of each pair is positive on mark and earth on space, the other (lower) is positive on space and earth on mark. The test point for the character "A" is connected via 5 rectifiers to 5 input terminals as shown, and can only go positive if the input signal is MMSSS. Point "A" going positive applies a positive potential to output terminals, 3, 4 and 7 giving the 7-unit permutation SSMMSMS at the output.

The output of the coder is converted by the transmitter element distributor to a sequential aggregate signal which is passed to the radio transmitter. The output drive stage includes a circuit which inverts the elements of channel B characters.

Receiver Circuits.—The elements of the incoming aggregate signal to the receiver are examined at their nominal mid-instants, and registered in the correct sequence by means of the receiver distributor, the elements of channel B characters being automatically re-inverted. The 7-wire output of the register is applied to the decoder for translation to 5-unit code. As each character is registered, the number of mark elements is counted by the error detector unit, and if acceptable (3 marks) the decoder output is transferred to the appropriate channel store. The 5-unit signal is read out of store sequentially via output gates by a distributor operating at the required speed of 50 or 45.45 bauds. Start and stop elements are added, and the composite output is passed to the receiving printer. If a supervisory signal is received, continuous start or stop polarity is applied to the output wire.

Repetition Circuits.—If the error detector indicates an incorrect mark element count, or the decoder detects the RQ combination, a repetition cycle is initiated on the appropriate channel. In this period (4 characters for 3-character storage) continuous stop polarity is normally applied to the receiver channel output wire to hold the printer. In the transmitter, the input character stepping device is stopped to permit the transmission of the RQ signal followed by a repetition of the characters in the channel store. As these characters are transmitted, they are automatically stored again in case a further repetition is required. At the end of repetition cycling normal traffic is resumed. The repetition cycle is shown in Fig. 5. Character C transmitted in the master-slave direction on channel A is falsified in transmission and detected as an error.

(*Continued on page* 33)

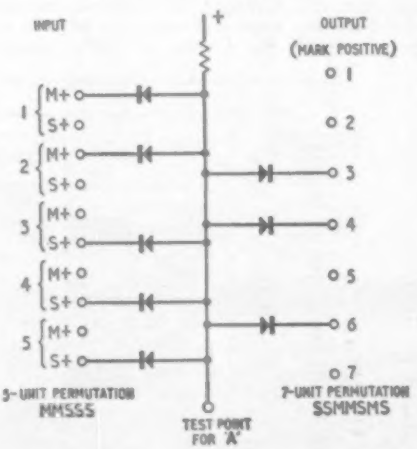
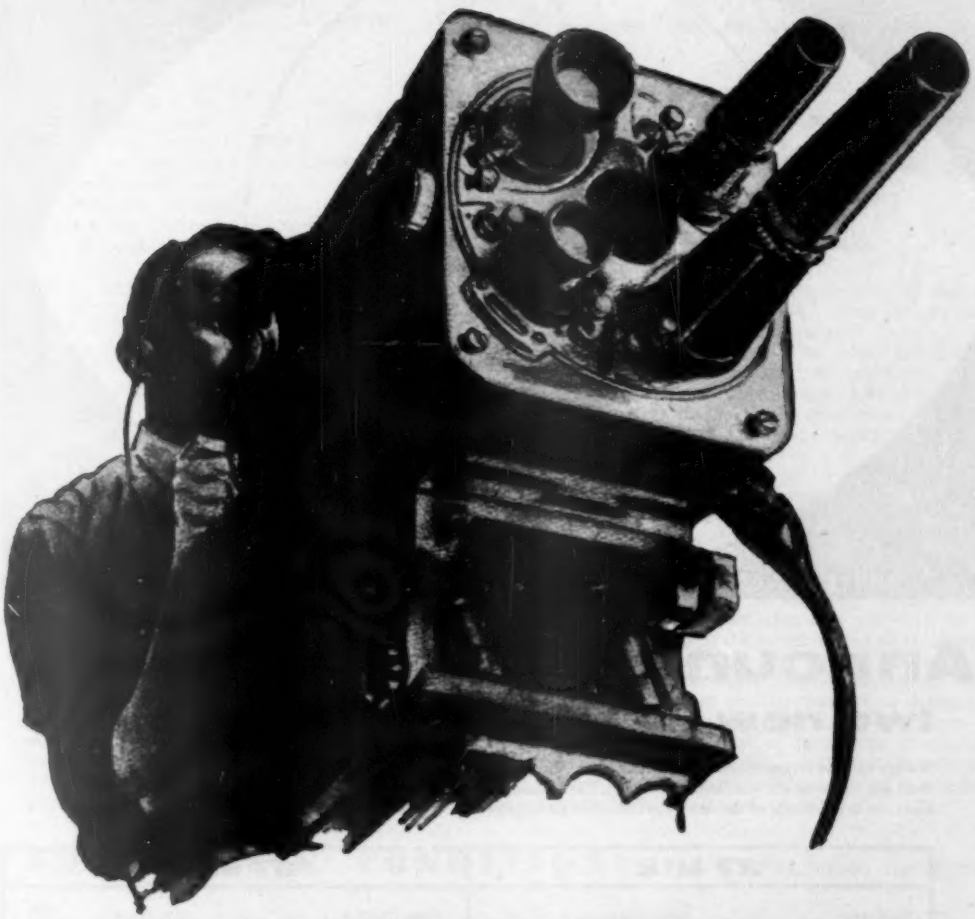


Fig. 4. Translation of the character "A" in the coder.

Marconi in Television



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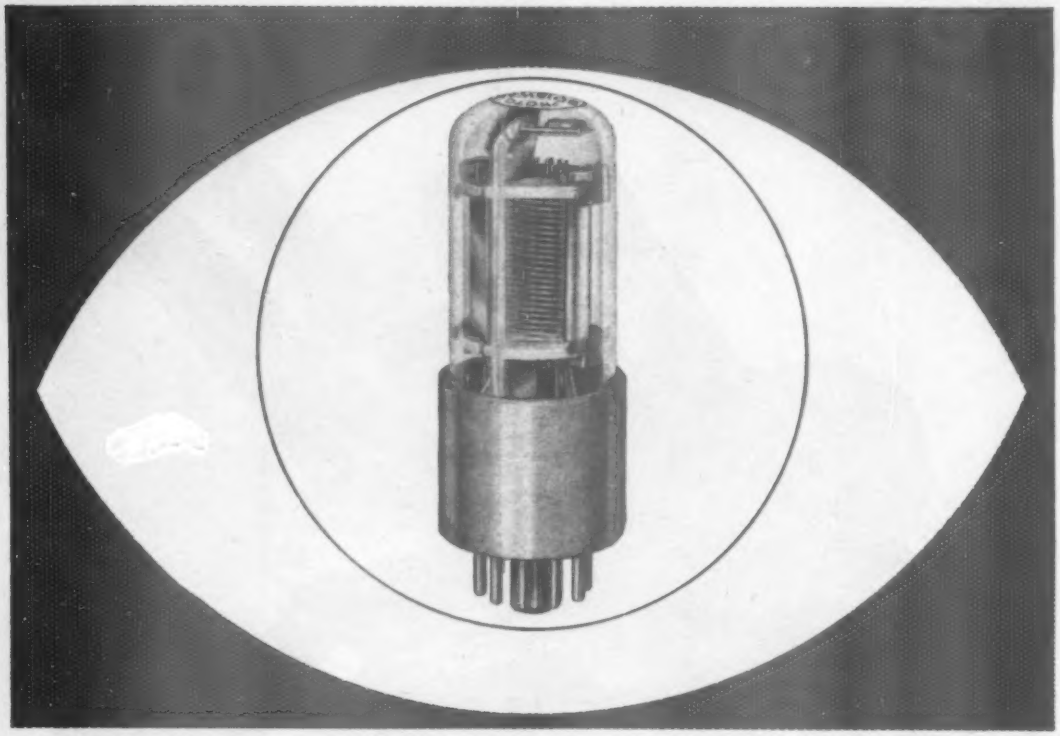

Announcing
two new EDISWAN Photomultipliers

We are pleased to announce two new Ediswan Photomultipliers: Type 27 M12 and Type 27 M13.
Both are based on the well-known Ediswan Photomultiplier Type 27 M1.
Here are brief details of the new types (further particulars will be gladly given on request):

27 M12

Nine-stage Photomultiplier specially designed for use in aircraft and other locations where strong vibration is experienced.

Base:	Flying Lead
Cathode:	Blue Sensitive
Av. Cathode Sensitivity:	20 μA/lumen
Max. Anode Current:	1 mA
Typical Operation:	
Volts per stage	65V
Volts anode to secondary cathode	65V
Sensitivity (white light)	1.0 A/lumen
Average Current Amplification	60,000
List Price: £18.0.0	

27 M13

Seven-stage Photomultiplier with twin anodes. These provide a double output, which remains well matched under all conditions.

Base:	11 pin sub-magnal
Cathode:	Blue sensitive
Av. Cathode Sensitivity:	15 μA/lumen
Max. Anode Current:	1 mA
Typical Operation:	
Volts per stage	125V
Volts anode to secondary cathode	50V
Sensitivity (white light)	2·0 A/lumen
Average Current Amplification	13,000
List Price: £16.0.0	

Other Photomultipliers in the Ediswan range.

27 M1 Standard high sensitivity type (9 stage)	List price £15.0.0.
27 M2 Lower sensitivity (9 stage) type	List price £ 8.0.0.
27 M3 Sensitive to near ultra violet (9 stage)	List price £16.0.0.

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The channel A receive printer at the slave station is stopped for 4 character periods, and, at the first opportunity following the receipt of the error, channel A transmission is interrupted in the slave-master direction to send the repetition request (RQ signal) followed by 3 characters from storage (M, N and O). Receipt of the RQ signal at the master station initiates a repetition of the stored characters C, D and E. It can be seen from the diagram that any further errors in either direction during the period of the repetition cycle will be rejected.

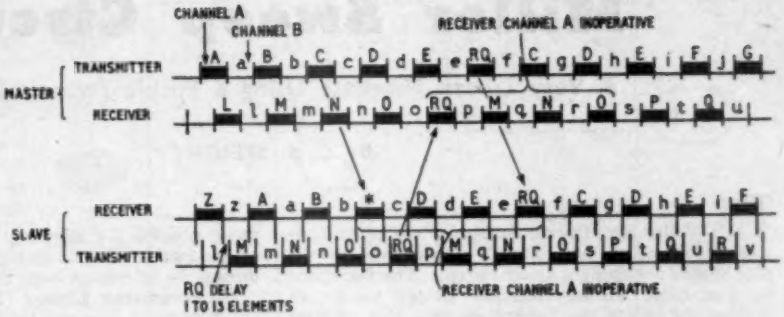


Fig. 5. Repetition cycle after error detection in the Autoplex.

Other Facilities.—A "tested RQ" facility can be provided to give some protection against undetectable errors. During a repetition cycle one of the received characters should be the RQ signal. If this is not detected owing to bad propagation conditions which may cause transpositions and undetectable errors, the repetition is ignored and another repetition cycle requested.

As an alternative to error correction by repetition, or when no return circuit is available, an error indication facility is provided. On detecting an error, the 5-space combination is transmitted on the start-stop output wire causing a special error symbol to be printed on a suitably modified teleprinter.

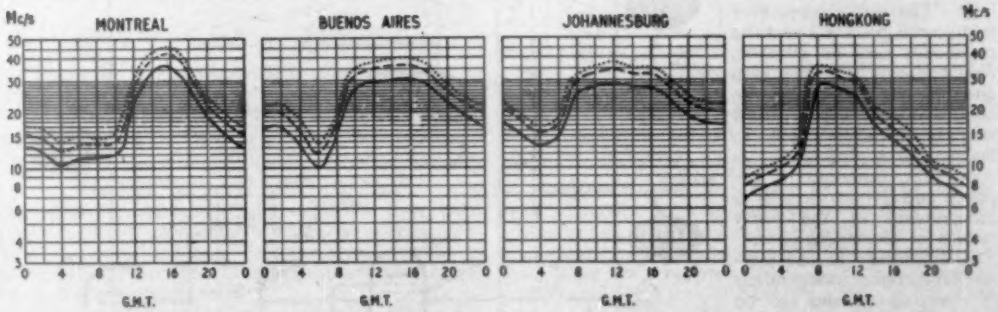
Out of phase operation may be recognized when in a specific period of repetition cycling the RQ signal is not detected. Phasing is accomplished by omitting a drive pulse to the receiver distributor not more than once per repetition cycle until the RQ signal is recognized on each channel. Each drive pulse omitted has the effect of shifting the receiver examination circuits relative to the signal by a step of one element. This action can be manually controlled or automatic.

Ancillary Equipment.—The basic error correcting equipment is generally designed for a 5-wire simultaneous input to the transmitter channel units. A 5-wire tape reader is then used when the information to be transmitted is prepared on perforated tape.

Adaptors are necessary when the input is sequential from a remote auto-transmitter or from the Telex network. If the remote auto-transmitter is driven by release pulses from the main equipment a simple sequential-to-simultaneous converter unit with one character storage is required. For connection to Telex or a free-running auto-transmitter where the rate of reception and clearance of characters may differ, a converter with buffer storage for several thousand characters (which may be, for example, in the form of a loop of perforated tape) is required. Another ancillary item is a channel subdivider unit to permit the input characters to a channel to be derived in turn from a number of remote auto-transmitters, and also to allow the output to be distributed in turn to a number of remote printers.

SHORT-WAVE CONDITIONS

Prediction for January



THE full curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during January.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

•••••••• FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY

——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

Miller Sweep Circuit

A Very Linear Timebase Using a Puckle Flyback Circuit

By C. S. SPEIGHT

THE Miller and Puckle timebases are often considered as being two distinct approaches to the problem of obtaining a linear sweep. The variations on the basic Miller-integrator circuit nearly all involve the use of the suppressor grid of a pentode as the switching electrode and they differ mainly in the method of generation of the switching pulse; whereas the Puckle timebase varies in the type of sweep-generating circuit used. A plain resistor-capacitor combination will suffice for some purposes; but for more linear sweeps a pentode is commonly used to produce a constant-current discharge from the capacitor by making use of the high "r_a" of a pentode. The linearity of output from such a circuit is still not very good and difficulties arise in calibrating the sweep speed and stabilizing it against variations in valve characteristics, etc.

However it is possible to combine the linear sweep characteristics of the Miller circuit with the Puckle recharging circuit to produce a timebase which is simple and yet superior to the more usual Miller-transitron circuit in almost every respect.

Some advantages of such a circuit may be listed as follows:—

1. The Miller integrator operates with an infinite load during the sweep period so ensuring an extremely high degree of linearity.

2. The current recharging the sweep capacitor may be high compared with the discharge current. This means that the ratio of sweep period to flyback period can be made very much better than in the Miller-transitron in which a compromise is made between a high stage gain without feedback (high anode load) and a high recharge current (low anode load).

3. The use of suppressor and screen grids as switching electrodes can be avoided, resulting in a high loop gain and fast transition from one condition to the other. Thus the circuit lends itself to high-speed applications.

4. The initiation of the sweep and flyback periods is independent of the parameters of the sweep circuit. The amplitude of the sawtooth is therefore independent of sweep speed and can be controlled accurately.

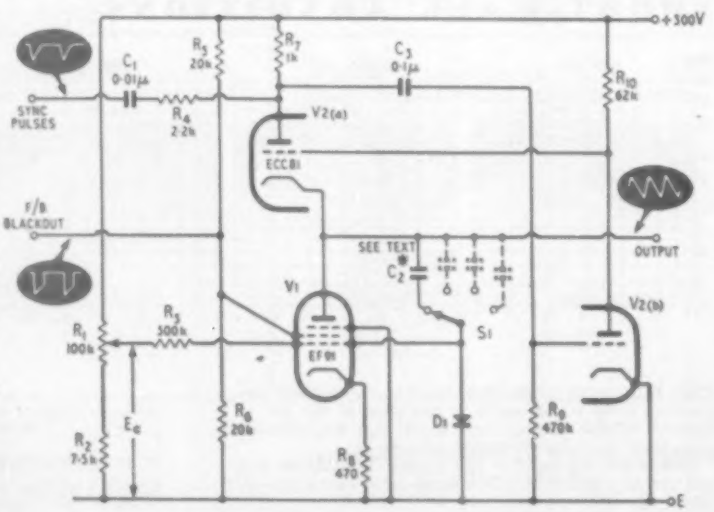
5. The initial "fast" region or "Miller step" associated with nearly all adaptations of the Miller circuit, can be eliminated almost completely. This is made possible by allowing the control grid voltage of the sweep valve to change only one or two volts during the transition from flyback to sweep.

Free-running Linear Timebase—The circuit for a general purpose timebase incorporating the above features is given in Fig. 1. Only two valves are used: V1 is the Miller sweep valve, V2 is the Puckle "multivibrator." R_1 and S_1 form the fine and coarse speed controls.

The operation of the circuit is most easily seen by starting during the sweep period. V2(b) is conducting heavily ($I_a \approx 4$mA), its anode potential being given by the point at which the load line and the "$V_g = 0$" curve intersect. The anode potential of V1 is more positive than that of V2(b); therefore V2(a) is held cut-off. The charging current, flowing through R_2 into the sweep capacitor C_2, provides the total anode current of V1, which is constant because the grid voltage is required only to change sufficiently to maintain this current at reduced anode voltage.

Therefore the rate of fall of voltage at V1 anode is constant until only a few volts exist between the grid and cathode of V2(a); which then starts to conduct. The drop in anode potential is transferred by C_3 to the grid of V2(b) where it reduces the anode current so allowing V2(b)'s anode potential to rise. Since V2(b) anode is directly coupled to V2(a) grid, the current is further increased in V2(a). A cumulative action occurs limited by V2(b) being cut-off and V2(a) forced into heavy conduction; thus the sweep capacitor, C_2, recharges through the diode action in

Fig. 1. Free-running linear timebase. (The mark-space ratio of the waveforms shown is less than the actual value).



V2(a) (grid and cathode), R_{10} and D_1. The anode voltage of V1 rises until the current in V2(a) can no longer produce sufficient voltage across R_7 to maintain V2(b) cut-off; then V2(b)'s anode potential falls which reduces the current in V2(a) still further. Again a cumulative action occurs, this time limited by the return of V1 and V2 to their original conditions, thus allowing the sweep to start once more. It follows that the lower limit of sweep voltage is determined by the anode potential of V2(b) when conducting and hence by R_{10}. The upper limit is determined mainly by the value of R_7, the "r_a" of V2(a) and the grid base of V2(b). If the value of R_7 is too low; the flyback will end too soon and the loop gain will be low; if it is too high the sweep will not start until C_3 has discharged through R_9. (This occurs if the circuit components are so chosen that the circuit finds a "stable" condition, with V2(a) running at "$V_g = 0$," with anode current equal to that of V1.)

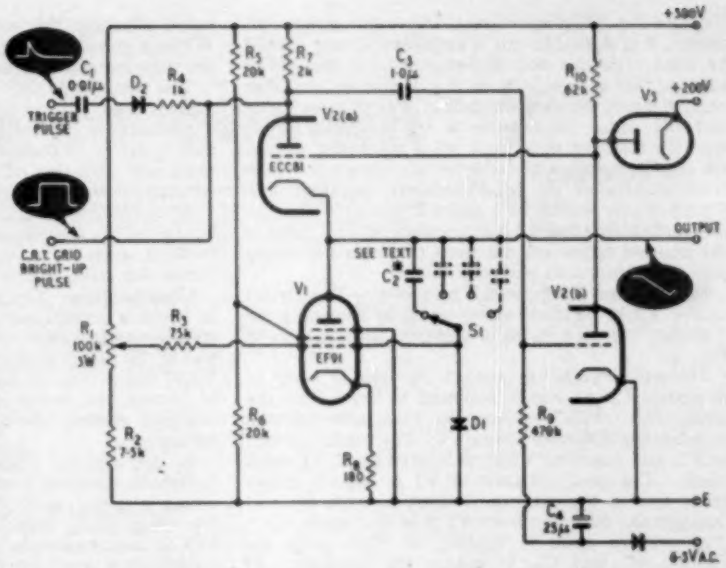


Fig. 2. Adaptation of the free-running circuit to provide triggered (single-shot) high-speed timebase.

R_6 is introduced to limit the current drawn by the pentode during flyback to about 4mA, the grid potential being limited to h.t. negative by the diode D_1. The latter should have a back resistance of at least 1MΩ at a reverse voltage of about 5 volts, and a forward current rating of at least 20mA under pulsed conditions. (Most point contact germanium diodes satisfy this requirement.)

Values of sweep capacity are not given since they are best left to suit individual requirements. An approximate formula for obtaining the value of C_2, in terms of the minimum sweep duration required on that range, may be obtained from:—

$$C = \frac{it}{V}$$

(where the symbols have their usual meaning).

Substituting i = 1mA, V = 150 volts.

$$C_2 \approx \frac{7t}{10^6}$$

(C is in farads and t is in seconds.)

Values of C_2 between 15pF and 0.1μF have been found suitable, providing a range of speeds from 2μsec to about 0.2 sec. (As the stray capacity is likely to be of the order of 15pF, the lower limit will be something over 2μsec.)

The flyback-blanking pulse is taken from V1 screen and synchronization is effected by injecting negative pulses into V1(b) grid (via C_1, R_2, C_3). The amplitude of these pulses may be as small as 0.25V to produce synchronization because they are amplified and reversed in polarity by V2(b) before they are applied to the grid of the cut-off valve V2(a).

Linearity—Although the cathode current of V1 does increase slightly throughout the charging period, the change in voltage developed at the cathode is negligible due to the low value of R_5. And, because the screen current is less than 5% of the current drain through R_3 and R_4, the screen potential is also substantially constant throughout the same period.

The change in grid voltage is given by :—

$$\Delta V_g = \frac{\Delta V_a}{\mu}$$

where ΔV_a is amplitude of saw-tooth at V1 anode and μ is amplification factor of V1.

Change in charging current is therefore:—

$$\frac{\Delta V_g}{R_3} = \frac{\Delta V_a}{R_3\mu} \text{ (assuming } E_c \text{ is constant)}$$

Non-linearity (%) is:—

$$\left[\frac{\Delta V_a}{\mu R_3} \div \frac{E_c - V_g}{R_3}\right] . 100 \approx \frac{\Delta V_a}{\mu E_c} . 100$$

substituting:

ΔV_a = 150 volts, μ = 7,000 (typical value for EF91)

E_c = 300 volts (max. value)

$$\text{Non-linearity} = \frac{150}{7{,}000} \times \frac{100}{300} \approx 0.007\%$$

Although output impedance of a Miller circuit can be shown to be as low as that of the cathode-follower ($Z_{out} \approx 1/g_m$) the use of this advantage of the circuit by feeding the output into resistive loads which are low compared with the "r_a" of the valve must result in a loss of linearity. This arises from the fact that the anode current of the sweep valve and hence the grid potential, has to change appreciably during the sweep period to reproduce the saw-tooth across the load. Consequently the charging current $(E_c - V_g)/R_3$ cannot be constant. Therefore, if this circuit is to feed a device having an input impedance of such a value that it would shunt the

" r_a " of the Miller valve ($\approx 1M\Omega$) to any appreciable extent, it is desirable that a cathode-follower should be used to isolate this impedance from the Miller valve. This is especially so if a paraphase amplifier is used, where the combined effect of stray capacitance and the input impedance of the amplifier could spoil the inherent good linea ity of the sweep circuit. An amplifier with a high degree of negative feedback is recommended: the anode-follower operating with a gain of one would be a suitable circuit. Usually, for oscilloscope work, the linearity of the tube is the limiting factor and for most purposes the sweep may be regarded as perfectly linear.

High-speed Triggered Timebase.—The circuit of Fig. 1 may be made mono-stable by returning the " earthy " end of R_8 to a negative potential, as in Fig. 2.

Normally V2(b) is cut-off by the 9 volts or so across C_4: its anode potential is limited by the diode, V3. V2(a) behaves as a cathode follower maintaining 200 volts across V1. The anode current in V1, and hence in V2(a), is limited by R_8 to about 7mA. The grid potential of V1 is slightly above earth due to the current flowing through R_3 and through the diode between V1 grid and earth.

A positive pulse is applied to V2(b) grid, via C_1, D_2, R_4 and C_2, to trigger the timebase. If the amplitude is sufficient to cause V2(b) to conduct, an amplified negative pulse will appear at its anode and therefore at V2(a) grid where it reduces the current in the valve. The resulting positive pulse at V2(a) anode adds to the pulse that initiated the process and once the loop gain exceeds one the action is cumulative, limited by V2(a) cutting-off. V2(b) is then conducting heavily and the sweep starts. The anode potential of V1 falls linearly and from this point the action is the same as that occurring in the free-running circuit, except that at the end of the flyback, the voltage across R_7 is not allowed to fall to such a value that V2(b) can conduct (the value of R_7 is therefore increased from $1k\Omega$ to $2k\Omega$.).

It will be seen from Fig. 2 that the maximum charging current flowing through R_3 is equal to 300/75 = 4mA (1mA in Fig. 1). The expression for C_3 will have to be modified accordingly:—

$$C_3 = \frac{7t}{10^6} \cdot 0.25.$$

This increase in current is a desirable feature of a high-speed timebase; because there is a limit to the minimum value of sweep condenser (about 15pF), and the greater the charging current—the higher the upper limit of sweep speed. The increase has been made possible at the expense of recovery time, as compared with the free running timebase.

The same remarks as before, concerning linearity, apply to the triggered timebase; but several other points may require clarification.

At high speeds, it is generally more difficult to produce the beam brightening pulse than to initiate the sweep. To brighten the trace a definite excursion of voltage in (ideally) zero time is required, whilst sweep-initiation requires only a finite rate-of-change of voltage. For this reason the bright-up waveform is taken from the same current path as the sweep waveform (see Fig. 2). so that the beam is " turned on " at the same time as the sweep.

The semi-conductor diode, D_2, is inserted between C_1 and R_4 to reduce the possibility of any negative pulses which may appear after the main triggering pulse affecting the state of conduction of V2(a). Without this diode the circuit may be used to give the time integral of a pulse.

The amplitude of triggering pulse should be greater than 10V to ensure consistent results, and, if necessary, it should be passed through a differentiating circuit to reduce the pulse duration to something less than that of the sweep. Apart from this restriction the shape of the pulse is not critical.

No particular valve is quoted for V3, as practically any small thermionic diode will give the required forward current of about 2mA, and the voltage across the valve at this current is not critical.

Conclusions—The two circuits given are meant to be of a general nature and are easily adapted to specific applications. For example, by limiting the end of the sweep with a diode connected to " catch " V2(b) anode (Fig. 2), an accurate pulse-delay circuit is formed (the sweep duration depends only on the charging current, the limits of sweep and the sweep capacitor).

In applications where a higher ratio of sweep-to-flyback duration is required (that of the existing circuit is as high as 30 : 1 when E_c is at its minimum) the value of R_3 may be increased and a strapped ECC91 could take the place of V2(a). The latter modification also increases the amplitude of the output. Should this prove a desirable feature the value of R_7 and R_{10} may be increased to $1.5k\Omega$ and $100k\Omega$ respectively.

Usually this is not worthwhile for use as a c.r.t. timebase because this usually necessitates the use of a paraphase amplifier which effectively doubles the output.

The circuit of Fig. 1 has been used in a general purpose oscilloscope and has proved very satisfactory, producing an almost-ideal saw-tooth. It is difficult to say whether the linearity estimated for this circuit is realized in practice due to the difficulty in detecting such a small percentage (0.007%), but examination of the grid waveform at a deflection sensitivity of 0.5V/cm revealed no change in voltage throughout the sweep period. Assuming that the change was just undetectable (about 0.05 volts) the percentage non-linearity would still be 0.017%, which represents, to all intents and purposes, a perfectly linear sweep.

Electronic Velocity Analyser

IT is surprising that in these days of comprehensive instrumentation it is still difficult to measure accurately some transient events. One of these is velocity measurement. "EVA," developed by Marconi's W/T Co., Ltd., is designed to do this automatically, giving a highly accurate continuous record of velocity against time on a paper strip. It is a small portable instrument using X-band Doppler radar to provide the information. The range of the basic equipment is 600 ft on targets of at least $\frac{1}{2}$ sq. metre radar reflecting area. The use of a superhet receiver will nearly double this and even greater ranges can be achieved by modifications to the aerial system and transmitter.

The lowest speed range is 2 to 80 m.p.h. This can be extended virtually as far as is desired by the use of ancillary units, for instance, a 60 kc/s oscillator and detector extends the range to 3000 ft/sec. The equipment is thus equally suitable for measuring braking performance of cars or the speed attained by guided missiles. In this latter application the use of "EVA" saves the processing and correlation of many thousands of readings.

Aspects of design 7

SYNCHRONISING PULSE SEPARATION

This is the seventh of a series of special features dealing with advanced problems in television and radio circuit design to be published by Siemens Edison Swan. The Ediswan Mazda Applications Laboratory will be pleased to deal with any questions arising from this or other articles, the eighth of which will appear in the February 1959 issue.

The need for accurate and stable synchronisation of the scanning circuits of a television receiver under widely varying signal conditions requires the consideration of a number of factors in the design of circuits for separating the line and frame synchronising signals from the video information. These may be summarised as:—

(1) Removal of all picture modulation.
(2) Reduction of synchronising pulse disturbance by noise or impulse interference.
(3) Removal of line frequency components from the frame synchronising signal.
(4) Deriving frame synchronising pulses of identical shape and amplitude in successive frames.

These points are considered in more detail in the following paragraphs in relation to the normally used method of modulating the cathode of the picture tube, where the synchronising pulses are the most positive part of the video signal voltage. The simple but effective circuit shown in Figure 1 serves to illustrate the features in conjunction with the voltage waveforms in the region of one frame synchronising signal drawn in Figure 2A. A 30FL1 triode-tetrode valve is normally used but a 30F5 pentode with one section of a 6/30L2 double triode is an equally suitable combination which can be used in circuits where the component values are identical with those shown in Fig. 1.

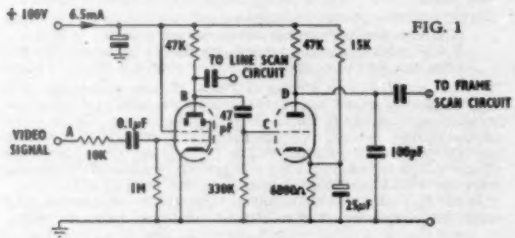


FIG. 1

REMOVAL OF PICTURE MODULATION AND INTERFERENCE

A limiter circuit using a tetrode or pentode arranged to operate with characteristics of the form shown in Figure 3 removes the picture modulation and gives a voltage output corresponding to the television synchronising pulse waveform alone. The charging of the coupling capacitor by grid current during synchronising pulses maintains the top of these pulses at a constant level due to the long discharge time constant. A resistor in series with the coupling capacitor serves to reduce both the effective capacity loading of the previous video amplifier stage and the amplitude of high frequency components of noise and interference signals. Its maximum value is limited by the tolerable distortion of the shape of the synchronising pulses and variation of clamping level.

Operation at a low screen voltage results in a short grid base giving limiting action down to a low input signal level. A high anode resistance also gives limiting action at the tip of the synchronising pulses as the anode voltage rapidly falls to a low value. This removes noise and interference pulses and gives an output waveform corresponding to a narrow "slice" of the input signal (Figure 2B).

Sharp negative pulses for direct synchronising of the line scanning circuit may be derived by differentiation of the anode output, or, alternatively, suitably shaped signals may be obtained for use in the phase comparison circuits of "flywheel" line synchronising systems.

DERIVATION OF FRAME SYNCHRONISING SIGNALS

In order to separate the frame scan timing signals from the complete synchronising waveform it is usual to feed the signal to either a "differentiating" or an "integrating" network of selected time constant. The optimum time constant for best discrimination is 15 to 20 microseconds.

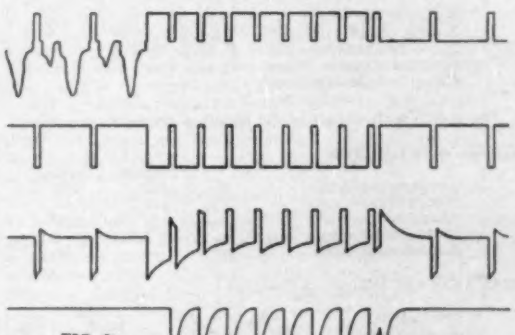


FIG. 2

The "differentiating" method is preferred as the sharper pulses result in more definite timing of the frame scan. This should be followed by a clipping valve to remove the residual pulses at line frequency which are liable to cause poor interlace. The triode valve in the circuit of Figure 1 performs this function, being biased beyond cut-off on its cathode except during the frame synchronising signal when the pulses drive it to grid current (Figure 2C). This grid current levels the top of the signal so that the output voltage at the anode consists of eight negative-going pulses of practically equal amplitude (Figure 2D). This ensures synchronising the frame scan circuit on the first pulse and gives reliable interlace provided that the end of flyback of the frame scan generator is arranged to avoid the last of the frame synchronising pulses.

Another factor which may impair the frame interlace is coupling of pulses at line frequency through the grid to anode capacity of the triode when it is cut-off. These may be filtered out by adding a capacity from anode to chassis suitably chosen to avoid excessive distortion of the frame synchronising pulses.

The triode clipper described gives a peak pulse output of approximately 70 volts at the anode. If a smaller synchronising voltage is adequate for the frame scan generator, a suitably biased diode such as in the 6D2 double diode may be used as a clipper.

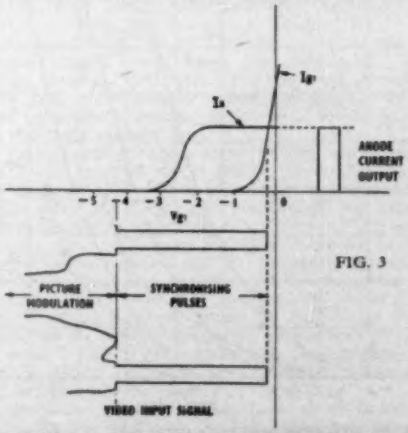


FIG. 3

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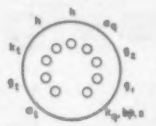
Technical Service Department, 155 Charing Cross Rd., London, W.C.2.
Telephone: GERrard 8660. Telegrams: Sieswan, Westcent, London

EDISWAN MAZDA 30FL1
GENERAL PURPOSE TRIODE-TETRODE FOR AC/DC MAINS TELEVISION RECEIVERS

B9A BASE



View of free end

Maximum overall length (mm)		56.0
Max mum seated he.ght (mm)		49.0
Max.mum diameter (mm)	..	22.2
Heater current (amps)	.. I_h	0.3
Heater voltage (volts)	.. .. V_h	9.4

MAXIMUM DESIGN CENTRE RATINGS

		Tetrode	Triode
Anode voltage (volts)	$V_{a(max)}$	250	250
Screen voltage (volts)	$V_{g2(max)}$	250	—
Anode dissipat.on (watts)	$P_{a(max)}$	3	2
Screen dissipat.on (watts)	$P_{g2(max)}$	1	—
Heater to cathode voltage* (volts r.m.s.)	$V_{h-k(max)}$	150	—

*Measured with respect to the higher potential heater pin.

CHARACTERISTICS

		Tetrode	Triode
Anode voltage (volts)	V_a	170	200
Screen voltage (volts)	V_{g2}	170	—
Anode current (mA)	I_a	10	10
Mutual conductance (mA/V)	g_m	7.5	3.4
Amplification factor ..	μ	—	16

CAPACITANCES (pF) (without holder)

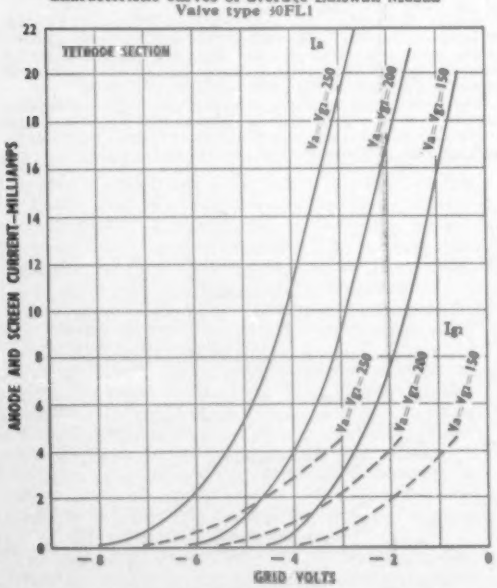
		Tetrode		Triode	
Grid/Earth	..	C_{g1-E}	7.9	C_{gt-E}	3.6
Anode/Earth	..	C_{aq-E}	3.2	C_{at-E}	2.6
Grid/Anode	..	C_{g1-aq}	0.05	C_{gt-a}	2.7

APPLICATION NOTES

The two sections of the Ediswan Mazda 30FL1 are completely independent. Both the internal shielding and the arrangement of the base connections result in a very low level of capacitive and electron coupling so that the sections may be used in diverse applications without their performance being significantly affected by interaction. The chart illustrates a variety of permissible combinations in a television receiver.

The triode sections of the Ediswan Mazda valves type 6/30L2, 30PL1 and 30FL1 have identical characteristics.

Characteristic curves of average Ediswan Mazda Valve type 30FL1



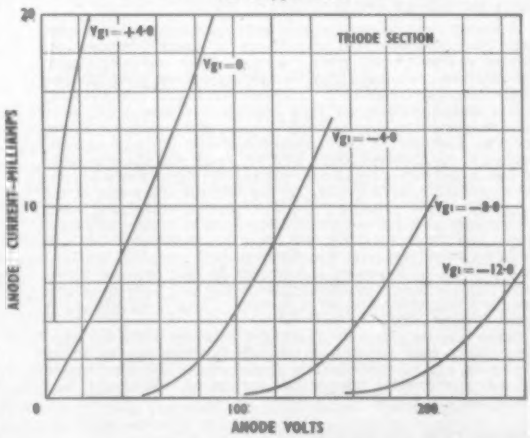
TRIODE SECTION	TETRODE SECTION: Sync. Pulse Separator	*Video Amplifier	Line Scan Generator	Frame Scan Generator
Frame Sync. Clipper	A	A	B	A
Line Sync. Phase Splitter	A	A	A	B
Line Scan Phase Comparator	A	A	A	B
Line Scan Generator	A	A	A	A
Frame Scan Generator	A	A	A	A
Gated A.G.C.	A	A	A	B
*Video Cathode Follower	A	A	A	B

NOTES:— A—These combinations are satisfactory for the types of circuit and component values normally used.
B—In general, these combinations should be satisfactory but extra care may be needed to minimise stray coupling in wiring.

* With an H.T. line voltage of 190 V, the use of the tetrode to provide picture modulation to the cathode ray tube is only recommended with an anode load resistance not less than 10 kΩ. The triode section is not recommended as a cathode follower to provide picture modulation to the cathode ray tube unless the effective capacity loading is low enough to give adequate frequency response with a cathode resistance not less than 22 kΩ.

If the H.T. line voltage is higher than 190 V, adequate output under limit conditions can be obtained with lower resistance values.

Characteristic curves of average Ediswan Mazda Valve type 30FL1



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EDISWAN MAZDA

CRC 15/26

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Raster

I AM pleasantly surprised to find on reading "Free Grid's" contribution in the December issue that even I should be able to help him.

As far as I can recollect the word Raster was first used in connection with television by Baron von Ardenne when in 1934 or 1935 he made his first cathode ray tube television receiver which worked with 180 lines. At least he was the first person from whom I heard the expression. It is basically German for the screen used in half-tone printing and is a logical choice of word for what it is intended to describe. We ought in English to refer to a "screen" of so many lines.

May I take this opportunity of thanking "Free Grid" for much constructive amusement which I have obtained from him for well over 30 years.

Taplow, Bucks. H. C. SPENCER.

Rigidity of Loudspeaker Diaphragms

FOR the same reasons as given by Mr. D. A. Barlow in his article in the Dec. 1958 issue, I started work three years ago on devising and perfecting a light and stiff cone material. On the pure chemistry side I had the collaboration of an American chemist, Mr. H. J. Luth. The outcome of that work was briefly mentioned in my "Audio Design Handbook" (Gernsback, New York, 1958) on page 158 where I write—"This material [has] a core of cellular material which is left in an unimpregnated condition so far as the air cells are concerned, but the bonding material is allowed to penetrate the fibres to form a hard lattice-work frame. On the outer surfaces a complete skin is formed of the very hard bonding material".

I submit that, although I didn't call the new cone construction a "sandwich", this invention does give practical effect to Mr. Barlow's needs, for speakers incorporating the principle have been on sale in the U.S. for some 16 months. They work extremely well in centrally-heated American homes but hygroscopy tests in my English laboratories showed them to be susceptible to damp atmosphere, and a good deal of work has had to be done to make them "waterproof". Of course all paper-coned speakers are hygroscopic to some extent, but adopting a stiff cone results in many complications, among which is the aggravation of any inherent defects in the system. What is good for paper cones is not necessarily good for stiff cones.

In contrast to Mr Barlow's expectation that a speaker of the type he mentions could only act over a narrow band of frequencies, experience has proved that it is quite possible to get from a single unit a smooth and very good response from 10 to 15,000c/s, beyond which I do not think it is really necessary to go. The mechanics of a stiff cone do not seem to conform to what has hitherto been accepted as conventional theoretical speaker design. More on this point cannot be given in a short letter.

Exton, Southampton. H. A. HARTLEY.

Stereo Under Fire

I FEEL it necessary to cross swords with Mr. G. A. Briggs, of Wharfedale Wireless Works, Ltd., over his letter on stereo in the November issue.

As long ago as 30 years a leading firm in whose employ I used to be, tried out stereo on disc. Due to the soft disc material and heavy pickups, it was obviously not practicable in those days, but it does prove that the idea is not a new-fangled gimmick.

Stereo not only largely overcomes the lack of perspective and sound source positioning, but also for some reason as yet unexplained technically, appears to give a much greater dynamic range than is in effect the case, and appears to show up the higher frequencies to a more marked extent than does a single-channel system.

There is one other point to be considered, and that is that many people can hear little above 9kc/s, and "hi-fi" to these people sounds no better than anything else. Stereo, with its added presence and spatial effect will be a great step forward in enjoyment of music and plays to these millions of people.

Whilst agreeing wholeheartedly with Mr. Briggs' contentions concerning pickups, I cannot agree with his idea that stereo has been launched too soon, as from my earlier remarks it would appear to be about 30 years overdue.

West Drayton, Middlesex. R. W. BRYANT.

IT seems to me that amongst all the talk about "stereo" sound, one point seems to have been overlooked. This is that what goes under the name of "stereo", or "3D" sound, is neither solid nor three-dimensional. It has only one dimension—width. It has neither height nor front-to-back depth. One can hear a train come in from one side and go out the other side, but one could not hear the angle of approach or recession; neither could one hear a rocket and know that it was going up at an angle of 75° over one's head.

Not of course that one particularly wants to do so, but I only mention these points to underline my contention that "stereo" is a misnomer.

Birmingham, 28. ROBERT G HASELER.

Disc Stereo

MAY I reply briefly to some of the points raised in your December issue?

I agree with "Free Grid" that for technicians and writers no new development can be launched too soon, but I had in mind the general public and those who supply them with equipment. Most people in the industry now agree that the launching of stereo discs before reasonable supplies of compatible pickups were available was an unwise step to take. Even at the time of writing, six months after the fiasco at the London Audio Fair, high-class stereo heads are unobtainable in the dealers' shops. I have obtained interesting specimens from the U.S.A., Denmark and Germany, but this does not help the man in the street.

I also agree with Mr. H. C. Rylatt that the playing conditions at the Radio Show were abnormal. The point is, however, that stereo pickups were overcome by the heat and humidity when "monaural" types carried on without wilting, so it would be foolish to scrap the more reliable type.

As regards performance, some writers are claiming that a stereo head is better than a "mono" type on single-channel discs. This is unlikely, because whatever you do in the design of a stereo head you can do better and more easily in the simpler type. To make a fair test, the two pickups should be mounted to play the same record groove, and be connected through a switch to the same two amplifiers and loudspeakers. As the stereo output—type for type—will be about 6 dB down, the volume control must be turned up when switching to the stereo pickup. In all our tests to date, the "mono" pickup gives more top, cleaner bass and better definition, but this (apart from h.f. response) would not apply to the playing of stereo discs.

In conclusion may I say that I am all in favour of good stereo, but, as Mr. B. Wallace points out, we can-

not go on ignoring solo items indefinitely. What I object to is any assumption that second-rate stereo will or should replace first-class single channel working.

Idle, Bradford. G. A. BRIGGS,
Wharfedale Wireless Works, Ltd.

Printed Circuits

IN extolling the virtues of the printed circuit, unit constructed TV your contributor "Diallist" indicates that he is rather out of touch with modern TV servicing conditions. Any reputable dealer of to-day, if he is to stay in business, must endeavour to have a faulty set back at his customer's house in working order within 24 hours of the original complaint being made. Given good engineers and no printed circuits this can nearly always be achieved. With the printed circuit units, however, the engineer must first definitely locate the fault and decide which unit is to blame. This is not always such an easy matter (e.g. many a poor frame lock has been traced to the video output stage).

Assuming that he guesses right the dealer must then apply to the manufacturer for a new unit, and judging from past experience, he will be very lucky if he gets it within a week. Meanwhile the faulty set must take up precious space in the workshop, and, to save his sanity, the dealer will probably have to lend the customer a set to keep him quiet.

I am sure that most engineers will agree that the only advantage of the printed circuit is that it cheapens production. Otherwise they are a necessary evil and to suggest that they are an aid to service is nonsense.

I understand that in the U.S. the better quality TV receivers are advertised as "definitely containing no printed circuits", and that surely speaks for itself.

London, N.W.6. A. G. TUCKER.

Unbiased Valves

"FREE GRID" avers that the word "valve" has come to mean a one-way device by common usage. As a civil engineer I wish to refute his suggestion. Valves have been in use for centuries to control the flow of fluids, i.e., liquids and gases. Of the many types available only one is intended to restrict the flow to one direction, viz., the reflux or non-return valve. Since in many hydraulic systems, e.g., water supply, flow is normally in one direction only under the influence of gravity or pumps (c.f. batteries or generators) the design of some types of valve has naturally tended to produce devices either intolerant of reverse pressures due to selective provision of machined faces, or incapable of functioning under reverse pressures as in the case of the ball valve in the cistern in the attic, or the common domestic tap, in which a loose plug is screwed down on to its seat against the normal flow.

Just because these valves have been specialized for use in one-way systems, it is not necessarily correct to class them as one-way devices.

The simplest types of valve are functionally two-state devices (albeit imperfect in action when changing over), being normally kept fully open or closed, e.g., sluice, gate and barrel valves which are very poor as flow rate controls having an exponential characteristic. They are the "switches" of the plumbing world. Reflux valves are the "diodes" (fortunately not normally subjected to a.c. which is anathema to the water engineer, being transient in character and potentially disastrous in effect, and known as "water-hammer"). Servo-operated valves are the "triodes", further electrode equivalents not being necessary.

It is, of course, dangerous to press an analogy too far. If "Free Grid" wishes to learn a little more about valves I suggest that he pays a visit to the Institution of Civil Engineers, where he can read a most interesting paper entitled "Control of Flow by Gates and Valves", by Horace Denton Morgan, M.Sc.(Eng.), M.I.C.E., in *Proc. Inst. C.E.*, Vol. 7, p. 537, dated April 9, 1957. After which I look to him for a definition of the phrase "common usage".

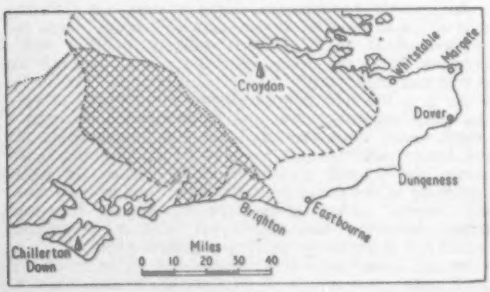
Newbridge, Midlothian. JAMES M. HOY.

I.T.A. NATIONAL COVERAGE

WITH the opening of the Burnhope, Co. Durham, station in January and the East Anglian and N. Ireland transmitters towards the end of the year, the I.T.A. will then be covering over 90 per cent of the U.K. population. The Authority's ultimate plans for a nation-wide coverage call for stations for a further three major service areas, each with populations large enough to support an independent programme company, and a number of satellites serving areas too small to "make financially possible the operation of independent companies."

The three major areas to be covered are S.W. England, N.E. Scotland and the Solway and it is hoped to bring the stations into service not later than the winter of 1960-61. S.W. England cannot be covered by only one Band III transmitter, as is done by the B.B.C.'s Band I station (North Hessary Tor), and it is, therefore, planned to build two stations, one in Devon and the other in Cornwall, both being operated by the same programme company.

The proposed Dover station is planned to serve the area outside the present I.T.A. coverage in S.E. England.



The first of the proposed satellites will be built near Dover and will come into service next winter. As already mentioned, these satellites are being introduced for an economic rather than a technical reason and will not, therefore, operate with the fly power one has come to consider to be the output of such stations; in fact, the Dover transmitter will have an e.r.p. of about 100kW in one direction. Satellites are also being considered for the Berwick area, W. Wales, Inverness, the Channel Islands and the Isle of Man, and possibly along the W. Coast of Scotland.

It is now certain that, despite the inconvenience, delay and expense involved in re-designing at the P.M.G.'s instigation the topmast of the B.B.C.'s tower at Crystal Palace in order to accommodate the I.T.A.'s London aerial, the Authority will not be using it. It intends to build its own tower at Croydon to replace the temporary 200-ft mast and to use a more efficient aerial, thereby improving the overall coverage of the London station. The I.T.A. is also planning the installation of a taller mast at Lichfield.

The completion of these plans by 1961 is expected to extend the I.T.A.'s service to something like 99 per cent of the population using only four of the eight channels in Band III. It still remains to be seen who will be given the other four channels.

THE "THIRD METHOD"

By J. F. H. ASPINWALL*

A New System of S.S.B. Generation

AN amplitude-modulated radio-frequency signal consists of a carrier radio frequency and two bands of frequencies at the sides of the carrier. These sidebands are caused by the addition and subtraction of the audio frequency to and from the carrier frequency, e.g. a carrier frequency (f_0) amplitude modulated by a 1,000 c/s audio tone will produce at the output of the modulator three frequencies (1) f_0 c/s, (2) $f_0 + 1{,}000$ c/s, (3) $f_0 - 1{,}000$ c/s, the latter two frequencies being the upper and lower sidebands respectively.

The "Filter" Method. In the "conventional" method of single-sideband generation, a carrier radio frequency and the audio-frequency signal are applied to a balanced modulator. The carrier frequency is balanced out of the output leaving only the sum and difference frequencies, i.e., the upper and lower sidebands.

With the aid of a complex filter one of these two sidebands is eliminated leaving a single-sideband signal for further amplification and transmission. The difficulties of this method are, in the main, the design, manufacture and, for commercial purposes, cost of suitable stable filters to operate at radio frequencies with high discrimination, and the care necessary to prevent breakthrough across the filter.

In this method of single sideband production, a downward shift of 1% in the filter pass band will, for a carrier frequency of, say 100 kc/s (a frequency commonly used for single sideband production), give a change in position of 1,000 c/s. This would mean that the filter would move part of its pass band over to the unwanted sideband. Assuming that the modulation frequency band required to be passed is 300 to 3,000 c/s, then the filter would pass frequencies up to 700 c/s in both sidebands and frequencies up to only 2,000 c/s in the upper sideband. Fig. 1 illustrates the vast change in operation which would occur for a change of only 1% in filter characteristic. This gives some idea of the stability required from a single-sideband filter operating at low radio frequencies. It also indicates why the lower frequencies of 50 kc/s or even 25 kc/s are used as carrier frequencies when using filters in the conventional method of single sideband production.

The "Out-phasing" Method.—Another method of single sideband generation, which is popular with amateurs because it does not require a complex and expensive filter, is the "out-phasing" method.

The audio input signal is applied to two broadband, a.f. phase-shift networks. These networks advance and retard the phase of the whole of the required audio spectrum by approximately plus and minus 45°. The audio-frequency outputs from the two networks thus have a relative phase shift of approximately 90°. The two audio outputs are applied separately to two balanced modulators. The r.f. carrier applied to these modulators is also in phase quadrature having passed through simple phase shift circuits giving plus and minus 45° phase shifts.

The resultant phases of the sideband outputs from these two modulators are such that, when combined, two of the sidebands add together and the other two subtract and cancel, thus leaving a single sideband output (Fig. 2). This method suffers from the disadvantage that unless the amplitudes are identical and the relative phase shifts are exactly 90°, the cancellation of the unwanted sideband is not complete: thus 1° of error in the phase shift gives an unwanted-sideband level of approximately −40 dB; 2° of error gives approximately −35 dB, 3° approximately −30 dB, etc. In practice it is difficult to design and build 45° phase shift networks to work over the broad audio frequency band required for speech which give this high degree of constancy of

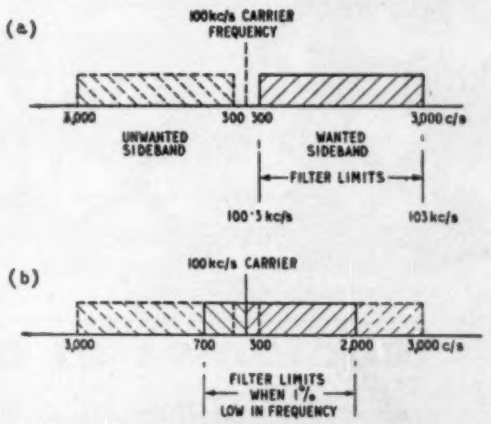


Fig. 1. (a) Diagram showing pass and rejection bands of filter for eliminating unwanted sideband in "filter"-type s.s.b. generator. (b) Effect of 1% drift (low) in pass band of filter.

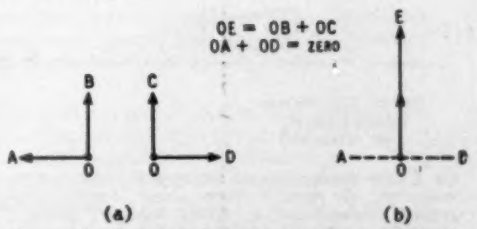


Fig. 2. (a) Outputs from modulators in "out-phasing"-type s.s.b. generator. OA, OB, OC and OD are sideband outputs (carrier suppressed by modulators) from modulators. Upper and lower sideband outputs are in phase quadrature to each other and the unwanted sidebands are 180° out of phase. (b) Combining the output results in OA cancelling OD and OB reinforcing OC, so giving a s.s.b. signal.

*Communications Laboratory, Redifon, Ltd.

attenuation and accuracy of phase shift. A compromise system is often used, which gives about 2° of phase-shift error at some frequencies, using high-stability close-tolerance components. This gives an unwanted sideband level of about −30dB to −35 dB which could interfere with users of the other sideband. Some equipments use filters after this type of s.s.b. generator to reduce the unwanted sideband still further. In this case the system is a combination of the conventional filter system and the phasing system and may suffer from some of the disadvantages and complications of both.

Another disadvantage of the out-phasing system is that the balanced modulators have to be balanced very accurately: they must be sufficiently stable to remain balanced for long periods of time if fully suppressed carrier operation is required. If even a small amount of carrier should appear it could cause interference with an operator using the "other" sideband of the channel, especially if he were using an automatic frequency-control system.

From the foregoing brief description, it will be seen that these first two methods rely on balancing out the unwanted products of a.m.—the carrier and the unwanted sideband, both of which, although undesired, are still generated.

A different and logical approach to the problem is to avoid generating the carrier or the unwanted sideband altogether. This approach is used in a method now known as the "Third Method" of single-sideband generation which was described by D. K. Weaver in the *Proceedings of the I.R.E.* for December, 1956.

In the following discussion, production of the upper sideband only will be considered for simplicity. The same general principles naturally can be applied to the generation of the lower sideband.

The "Third Method"—Consider the radio frequency spectrum to be occupied by the wanted sideband, say 3,000 c/s wide. It will be seen that this same spectrum could be occupied by a "carrier" frequency f_1 placed centrally in the wanted-sideband spectrum, and two "sidebands" each extending over half the width of the wanted sideband spectrum (double cross-hatched part of Fig. 3(d)). These two "sidebands" would be produced by modulating the "carrier" f_1, with audio frequencies of up to half the width of the wanted sideband, i.e. audio frequencies of up to 1,500 c/s.

Thus it is possible by modulating the offset "carrier" frequency f_1 with audio frequencies ranging from 0 c/s to 1,500 c/s to produce a frequency spectrum which will occupy only the wanted sideband width. At this stage we are considering only how to "fill" the required spectrum and restrict the radiated bandwidth. How this bandwidth is "filled" with the correct intelligence will be described later.

It is a relatively simple matter to produce a low-pass audio filter to pass 0 c/s to 1,500 c/s and attenuate rapidly above 1,500 c/s. The attenuation can be made as high as may be required with quite-wide-tolerance components. The stability of the filter need not be particularly good as, for example, a downward change of 1% in the filter pass band will only alter the width of the radiated sideband by a total of $2 \times 1\% \times 1{,}500 = 30$ c/s. The position of the sideband will remain unaltered because it is symmetrical about the fixed "offset carrier" frequency f_1.

Comparing this result with the result of the 1% drift in the "filter" method, it will be seen that the filter problem using the "third method" is greatly simplified, as it is easier and more logical to restrict the bandwidth to that of the audio spectrum at audio frequencies rather than at radio frequencies.

Having now produced a radio frequency spectrum which, by reason of the audio filter, cannot be any wider than 3,000 c/s, the problem is how to produce the correct intelligence in this spectrum.

For speech reproduction to be intelligible, there is no necessity to reproduce frequencies below 300 c/s, so this gives a lower limit of frequency to transmit. As we have selected a sideband spec-

(*Continued on page 41*)

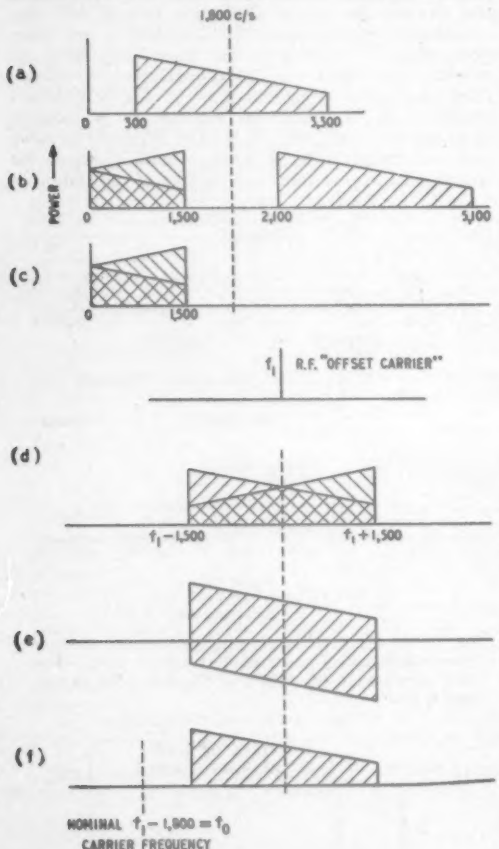
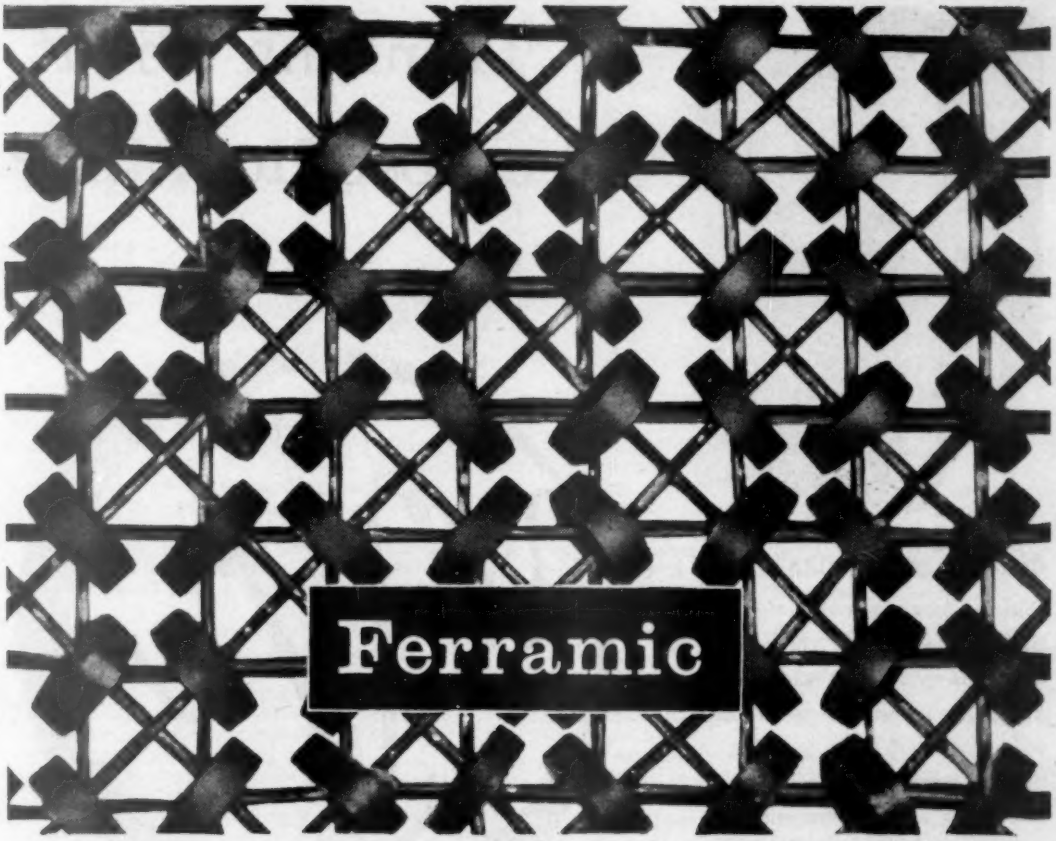


Fig. 3. (a) *Power/frequency spectrum of audio input to modulator.* (b) *Audio modulator output, nominal (suppressed) carrier frequency 1,800c/s. Note the "folding" of the lower sideband.* (c) *Output from low-pass filter, cut-off frequency 1,500c/s.* (d) *Output from first modulator chain (chain "B" in Fig. 5).* (e) *Output from second modulator chain (chain "A" in Fig. 5).* (f) *Sum of outputs of modulator chains "A" and "B" gives a single-sideband signal with nominal carrier frequency f_0, 1,800c/s below f_1, the r.f. carrier. Note that f_0 is not generated. N.B. The power/frequency spectra shown apply only to speech.*



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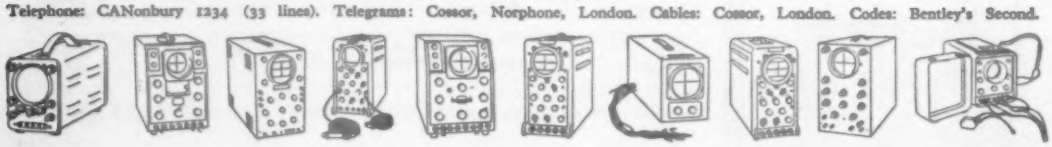

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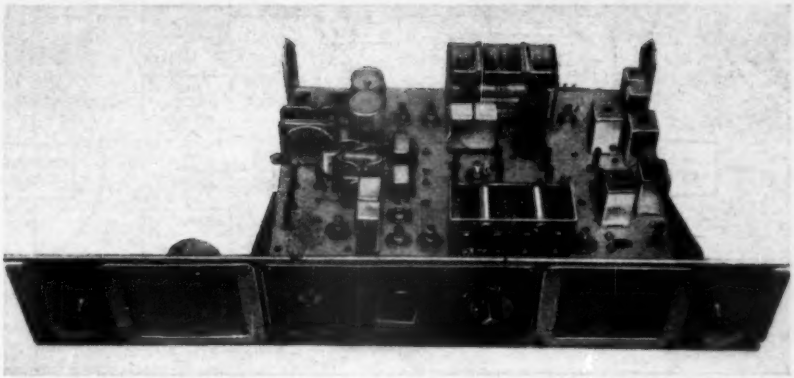


Transistorized modulator deck of the Redifon GR400 radiotelephone. The unit is 19in wide and 3½in high.

trum 3,000 c/s wide, the upper-frequency limit therefore will represent 3,300 c/s. Therefore the arithmetical centre of this band, which is the offset " carrier " frequency f_1, represents a single sideband frequency corresponding to 1,800 c/s. It should be noted that f_1 is not the nominal carrier frequency (f_o) (which is not generated and lies 300 c/s below the bottom of the spectrum which has been generated).

1,800 c/s, therefore, is the centre of the transmitted audio spectrum. If the audio input can be " folded over " on itself about the centre frequency of 1,800 c/s, then all the necessary information can be contained in a spectrum of only 0-1,500 cycles, which can then pass through the filter to the r.f. modulator (Fig. 3(b)).

The audio input spectrum can be " folded over " about the centre frequency of 1,800 c/s by applying both it and a 1,800 c/s tone to a ring modulator. The ring modulator can be balanced so as to remove all the audio-input frequencies and the 1,800 c/s audio-carrier voltage from its output. The output will consist then of the sum frequencies of 1,800 c/s plus audio of 300 to 3,300 c/s, i.e. 2,100-5,100 c/s (which will be removed by the filter) and the difference frequencies between the audio and the 1,800 c/s. For input frequencies of 300 c/s up to 1,800 c/s, the difference frequencies will be 1,500 c/s down to zero so that the lower part of the input audio spectrum will be inverted and reduced in frequency. Input frequencies of 1,800 c/s up to 3,300 c/s will produce beat frequencies of zero up to 1,500 c/s. This is the same resultant spectrum as for the lower frequencies and hence the whole of the audio spectrum will have been " folded " in two and reduced in frequency (Fig. 3(c)).

This " folded " spectrum thus contains the original information in a bandwidth of only 1,500 c/s.

As shown earlier, the " folded " spectrum can be used to modulate the " offset carrier " f_1 where the spectrum will be " unfolded " to occupy the full single-sideband spectrum of 3,000 c/s.

However, an ambiguity was introduced in the first modulator when the original audio spectrum was " folded over." Any given frequency in the output spectrum of 0 to 1,500 c/s could have been produced by a tone either above or below the 1,800 c/s audio carrier frequency. Similarly, when one frequency in the 0 to 1,500 c/s spectrum is used to modulate the " offset carrier " f_1, two " sidebands " are produced which correspond to the two possible audio frequencies in the original speech band. In other words, the sideband produced in this manner will contain equal amounts of direct and " inverted " speech. It will be seen at this stage that the nominal carrier frequency could be 300 c/s below the bottom end of the sideband spectrum or 300 c/s above. In the latter case, the same spectrum could be considered to be the lower sideband of another nominal carrier frequency f_o + 3,600 c/s (Fig. 3(d)). In either case, the unwanted inverted-speech component must be removed.

We have already seen that the phasing method of single-sideband production generates two sets of sidebands, by means of two separate and differently phased modulator chains, and then adds them together giving cancellation of the unwanted sideband and reinforcement of the wanted sideband.

A similar approach to this is used in the " third method " of single sideband production where the " wanted sideband " is considered to be the final frequency in the s.s.b. spectrum which represents the original audio frequency.

The " image " frequency representing inverted speech in the output spectrum is considered to be the " unwanted sideband."

To produce cancellation of the inverted sideband the first audio modulator, filter and r.f. balanced modulator are duplicated.

A relative phase shift of 90° is introduced between the 1,800 c/s tones supplying audio carriers to the two audio modulators. This is achieved by simple r.c. circuits which advance the phase of the 1,800 c/s a.f. carrier by 45° for one modulator and retard the phase by 45° for the other modulator. Similarly the phase of the offset " carrier " frequency f_1 is advanced and retarded by 45° for the two separate r.f. modulators as in the phasing method. It will be noted that the 90° relative phase shifts in both cases are produced at fixed frequencies (as distinct from the whole audio spectrum) and so can be made exactly 90° without any compromise being necessary.

The effect of the two different-frequency phase shifts in the two modulator chains is to produce " sidebands " of the " offset carrier " of such a phase relationship, i.e. quadrature, that when combined the inverted spectrum cancels and the wanted direct spectrum is reinforced in a similar manner to the reinforcement of the " wanted "

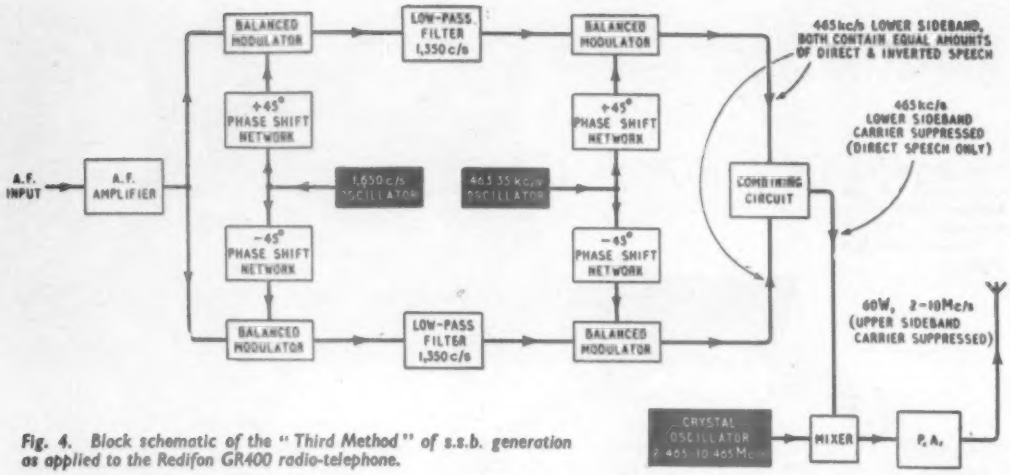


Fig. 4. Block schematic of the "Third Method" of s.s.b. generation as applied to the Redifon GR400 radio-telephone.

sideband in the phasing method of s.s.b. generation. (Fig. 3 (d, e and f).)

In this manner a true s.s.b. signal with fully suppressed carrier is produced. The s.s.b. signal may be developed at any required radio frequency, as filtering out of the unwanted sideband is not required at r.f. because none is generated.

If a "third method" s.s.b. generator is adjusted wrongly or suffers from tampering by unskilled personnel it cannot radiate outside its sideband spectrum. For instance, if the balance of the output modulators is disturbed then the "offset carrier" frequency f_1 will appear in the user's own spectrum as the equivalent of a sideband produced by an 1,800 c/s tone. The user will be the only person to suffer since this will give him a "whistle" in the centre of his own sideband spectrum.

Similarly, if the phasing or balance of the two channels is disturbed, the user again will be the only person to suffer since he will then produce a small amount of "inverted" speech entirely within his own sideband spectrum. Practical experiments have shown that removing completely the second modulator chain so that equal amounts of inverted and direct speech are produced does not render the signal unintelligible. The ear and brain cannot understand the meaningless "inverted" speech and thus tend to ignore it as an unwanted interference occurring at the same time as the intelligible direct speech.

This is a very useful feature of the "third method" since half of the generator can be damaged or a fault can occur in it; but in an emergency the equipment can still be used to produce an intelligible output.

The same system may be used in reverse for reception. A radio frequency will, if it is within 1,500 c/s of the "offset carrier" frequency f_1 produce an audio-frequency beat note which can be passed through the audio filters. If the radio frequency is more than 1,500 c/s away from f_1 then any beat note will be severely attenuated by the filters. The a.f. beat note of up to 1,500 c/s is then applied to the audio modulator whereupon the sum and difference frequencies between the a.f. beat note and the 1,800 c/s oscillator will be produced.

These two frequencies will represent a.f. "inverted" and direct speech. As in the generation of the s.s.b. signal, the addition of the outputs of the two modulator chains will, by reason of the phase shifts, give cancellation of the "inverted" speech and reinforcement of the direct speech.

When used for reception, the "third method" has the same advantages as when it is used for transmission. Any tampering or maladjustment of the circuits will not make the system unusable, it will merely produce either a whistle if the modulators are upset or a small amount of "inverted" speech; which, although perhaps annoying, does not make the signal unintelligible.

This method of single-sideband generation is used in the Redifon GR400 radio-telephone. In this equipment the s.s.b. generator and demodulator, together with the microphone and loudspeaker amplifiers, are combined into one small transistorized unit. In this case the audio oscillator operates at 1,650 c/s instead of 1,800 c/s and the low-pass filters cut off at 1,350 c/s instead of 1,500 c/s. This combination gives an audio frequency band 2,700 c/s wide centred on 1,650 c/s i.e. an a.f. spectrum of 300 to 3,000 c/s.

For convenience of switching radiated frequencies in the GR400 the s.s.b. generation and demodulation is performed at the fixed intermediate frequency of

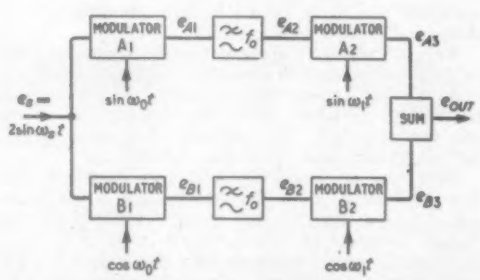


Fig. 5 Block diagram of "Third Method" modulator chains, showing signal relationships.

465 kc/s. When transmitting the s.s.b. output is mixed with a local, switched crystal oscillator to give the required radiated frequencies. When used for reception the output from a normal 465 kc/s receiver i.f. amplifier is applied to the unit. Fig. 4 shows in block form the application of these principles to the GR400.

Using this method of s.s.b. generation and demodulation the Redifon GR400 radio-telephone can achieve an overall "link" distortion (from microphone input of one GR400, via the radio circuit, to the loudspeaker output of another GR400) of 5 to 6%, which is very reasonable for a radio-telephone. Intermodulation products produced in the transistorized s.s.b. generator using the "third method" are 35 to 40 dB down, the non-linearity being mainly in the transistor amplifiers.

For those who would like to look more closely at the method of operation of the "third method" the following analysis may help.

For convenience let the input signal be

$$e_s = 2 \sin \omega_s t \quad .. \quad .. \quad (1)$$

(see Fig. 3(a) and Fig. 5.)

∴ The outputs of modulators A1 and B1 are:—

$$e_{A1} = e_s \sin \omega_o t \quad .. \quad .. \quad (2)$$

$$e_{B1} = e_s \cos \omega_o t \quad .. \quad .. \quad (3)$$

respectively where $\omega_o = 2\pi f_o$ and f_o is the frequency of the local audio oscillator.

Substituting (1) in (2) and (3)

$$e_{A1} = 2 \sin \omega_s t. \sin \omega_o t$$
$$= \cos (\omega_s - \omega_o)t - \cos (\omega_s + \omega_o)t \quad .. \quad (4)$$

and $e_{B1} = 2 \sin \omega_s t. \cos \omega_o t$
$$= \sin (\omega_s + \omega_o)t + \sin (\omega_s - \omega_o)t \quad .. \quad (5)$$

(see Fig. 3(b)).

$e_{A2} = e_{A1}$ less frequencies greater than f_o because of the filter

$$\therefore e_{A2} = \cos (\omega_s - \omega_o)t \quad .. \quad .. \quad .. \quad (6)$$

Similarly $e_{B2} = \sin (\omega_s - \omega)t$ .. .. .. (7)

(see Fig. 3(c)).

The output of modulators A2 and B2 respectively :—

$$e_{A3} = \tfrac{1}{2} e_{A2} \sin \omega_1 t = \cos (\omega_s - \omega_o)t. \sin \omega_1 t$$
$$= \tfrac{1}{2} \sin (\omega_s - \omega_o + \omega_1)t - \tfrac{1}{2} \sin (\omega_s - \omega_o - \omega_1)t \quad .. \quad .. \quad (8)$$

(see Fig. 3(e)).

$$e_{B3} = e_{B2} \cos \omega_1 t = \sin (\omega_s - \omega_o)t. \cos \omega_1 t$$
$$= \tfrac{1}{2} \sin (\omega_s - \omega_o + \omega_1)t + \tfrac{1}{2} \sin (\omega_s - \omega_o - \omega_1)t \quad .. \quad .. \quad (9)$$

where $\omega_1 = 2\pi f_1$ and f_1 is the frequency of the local r.f. oscillator (see Fig. 3(d)).

But $e_{out} = e_{A3} + e_{B3} = (8) + (9)$

$$\therefore e_{out} = \sin (\omega_s - \omega_o + \omega_1)t \quad .. \quad .. \quad (10)$$

(see Fig. 3(f)).

It should be noted that the nominal carrier frequency is represented by $\omega_1 - \omega_o$. (This frequency is not generated; therefore it cannot appear in the output.)

Commercial Literature

Constructors' Components and Accessories, a 100-page catalogue of over 4,000 items produced by well-known manufacturers. Available from Home Radio (Mitcham), 187, London Road, Mitcham, Surrey, price 2s including postage.

Cable-Makers' Instrumentation, including capacitance monitors, wire temperature indicator, high-voltage test sets, an analogue computer, etc. (13 main groups of instruments altogether). Brief details on a leaflet from the Addison Electric Company, Bosworth Road, London, W.10.

B.A. Spanners, double-ended, in chrome alloy steel, available singly or as sets in plastic wallets. Leaflet from Thos. Smith and Sons of Saltley, Saltley Mill, Birmingham, 8.

Automatic Synchronous Clock suitable for elapsed time measurements, etc., as an alternative to the more expensive process timers. Automatic reset is incorporated, and models are available with dials ranging from 0-30 seconds to 0-120 hours. Leaflet from the Electrical Remote Control Co., The Fairway, Bush Fair, Harlow, Essex.

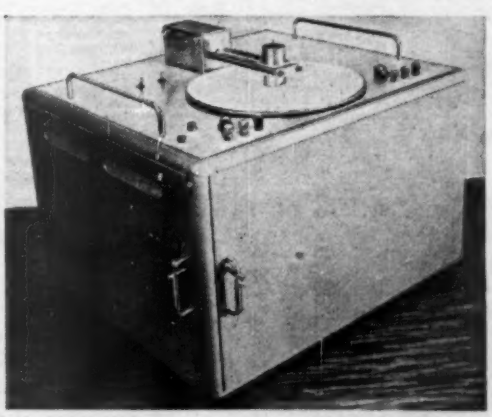
Marine Radar Simulator.—Systems are built up from three basic units—an operator's control box (mounted on the p.p.i.) and two types of instructor's racks of equipment. Simulation facilities for "own ship," up to five target ships, coastlines, tide effect, noise and clutter, etc., and three types of display. Brochure from Ultra Electric, Western Avenue, London, W.3.

Pocket Valve Data booklet of Mullard types, with characteristics, base connections and equivalents. Includes semiconductors and c.r. tubes. From Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1.

Magnetic-Tape Data Recorder with six tape speeds (1⅞ to 60 inches/sec), up to 14 tracks (on 1-inch tape) and frequency response of 100c/s to 130kc/s (at 60 inches/sec) on direct recording. For digital recording the p.r.f. can be up to 10kc/s, using the non-return-to-zero method. Recording by p.d.m. and f.m. carrier can also be used. Brochure on the FR-100A from the Ampex Corporation, 934, Charter Street, Redwood City, California, U.S.A.

pH Meter, self-contained, of the potentiometric type, requiring no special skill in operation. An electrometer valve is used and the accuracy is 0.05pH unit. Total range: 0-14pH units. Leaflet from the Doran Instrument Co., Stroud, Glos. Also leaflets on a thermo-couple potentiometer (range 2mV) and resistance boxes and bridges.

Magnetic Tape Containers in the form of "books" bound in red and black imitation leather, measuring 10in × 7¾in × 1¼in. Also racks for six of the "book" containers. Leaflet from the MSS Recording Company, Colnbrook, Bucks.



Automation in automation design is made possible by the Automatic Nyquist Diagram Plotter for servo-mechanisms manufactured by Servo Consultants Ltd., of 17, Woodfield Road, London, W.8. The output of an electro-mechanical frequency generator is fed into the servo-mechanism, the output of which feeds both an amplifier and phase detector. These in turn feed two servo-systems which automatically plot the phase and amplitude of the servo-mechanism from 0.25c/s to 100c/s.

GUIDE TO EUROPEAN BAND II STATIONS

THERE are now well over 800 f.m. sound broadcasting stations in Europe operating in Band II, and these are listed below. Following the carrier frequency in Mc/s we give, where known, the max. e.r.p. in kW, the station location and a symbol for the country (see abbreviations at foot of page). Where a station is operated by an organization other than the national broadcasting authority this is indicated in brackets. There are no U.S.S.R. stations in Band II. The Soviet broadcasting service uses the upper part of Band I and adjacent channels.

87.60		Poitiers (A.F.N.)	F
	80	Berlin*	G
	0.5	Geislingen	G
	100	Oldenburg	G
	0.1	Tegernseer Tal	G
	25	Wittlich-Hegau	G
	3	Würzburg	G
		M. Morello	Sd
		M. Sagne	Sd
		Vaberg	Sw
87.70		Ljubljana	Y
87.80	50	Caen	F
		Metz (A.F.N.)	F
		Austagder	No
		Hovdefjell	No
87.90	0.1	Stubnerkogel	A
		Pic du Midi	F
	7.5	Blauen	G
	40	Heidelberg	G
	0.1	Landshut	G
	100	Langenberg	G
	0.5	Lubeck	G
	0.5	Ulm-Wilhelmsburg	G
		M. Creo	I
		M. Vergine	I
		Teramo	I
		Rabat	M
	1.5	Celerina	Sd
	60	Oestersund	Sw
88.00		Dijon	F
		Sogn	No
88.10		Aalborg	D
		M. Venda	I
	60	N. Hessary Tor	U
	120	Sandale	U
88.20		Sonnwendstein	A
	100	Harz	G
	12	Raichberg	G
	5	Scharteberg	G
	15	Irnsum	Ne
	1	Leuk-Feschel	Sd
88.30		Taivalkoski	Fd
	0.5	Lindau	G
		Jerusalem	Is
		Borgo, Val di Taro	I
		M. Conero	I
		M. St. Angelo	I
		Sondrio	I
		Spoleto	I
	120	Sutton-Coldfield	U
88.50	0.3	Innsbruck	A
	9	Gelbelsee	G
		Fusino	I
		M. Scuro	I
		M. Serra	I
		Noto	I
		Trapani	I
	60	Pontop Pike	U
	60	Rowridge	U
		Maribor	Y
		Pohorje	Y
88.53	55	Feldberg-Taunus	G
88.54	50	Hamburg	G
88.60		Paganella	I
88.70		Pomarico	I
	60	Blaen-Plwy	U
	60	Meldrum	U
88.80	50	St. Pölten	A
	60	Berlin	G
	18	Burgstall	G
	2	Göttingen	G
	15	Lingen	G
	4.5	Mühlacker	G
	17	Kristiansand	No
88.85	0.1	Bad Mergentheim	G
	0.5	Braunschweig	G
88.90	10	Mikkeli	Fd
		M. Favone	I
		M. Limbara	I

*B.B.C. European Service

(88.90)		Maranza	I
		Pantelleria	I
		Luxembourg	L
	6	Llangollen	U
89.00		Bordighera	I
		La Spezia	I
		M. Venda	I
		Polcevera	I
89.05	3	Traunstein	G
89.10	50	Aalen	G
	0.1	Hochrhein	G
	60	Langenberg (B.F.N.)	G
		Ascoli Piceno	I
		Martina Franca	I
		Sulmona	I
	120	Wrotham	U
89.15	15	Nordhelle (B.F.N.)	G
89.20		Forssa	Fd
		Schwerin	G
89.25		Warsaw	P
89.30		Jerusalem	Is
		Alleghe	I
		Courmayeur	I
		Naples	I
		Ogliastra	I
	120	Holme Moss	U
89.35	60	Kreuzberg	G
89.36	50	Bourges-Neuvy	F
89.40	0.3	Beckdorf	G
	18	Bremen	G
	60	Hornisgrinde	G
	1	Rotbühl	G
		Borlänge	Sw
89.50		Chaumont (A.F.N.)	F
	3	Tammisaari	Fd
		Genoa	I
		Gorizia	I
		Marca Pusteria	I
		Mione	I
		M. Sambuco	I
89.60		Alkmaar-Winkel	Ne
	2	Llanddona	U
	6	Rosemarkie	U
89.69	90	Hoher Meissner	G
89.70	1	Pfunder	A
	150	Metz-Luttange	F
	0.5	Berchtesgaden	G
	0.5	Bonn	G
	0.5	Hardberg	G
	20	Hühnerberg	G
		Cascia	I
		Garfagnana	I
		Lagonegro	I
		Rome	I
		Stazzona	I
	120	Tacolneston	U
89.74	0.5	Würzberg	G
89.75	0.5	Cologne	G
89.80		Dresden	G
		Katowice	P
89.90	0.8	Baden-Baden	G
		M. Venda	I
		M. Soro	I
		Teramo	I
	120	Kirk o' Shotts	U
89.95	120	Wenvoe	U
90.00	90	Verdun (A.F.N.)	F
	10	Berlin	G
	3	Coburg	G
	25	Haardtkop	G
	15	Heide	G
	0.05	Monschau	G
	100	Waldenburg	G
	100	Wendelstein	G
		Casablanca	M
		Oujda	M
90.05	5	Aachen	G
		Novi Sad	Y
90.10	18	Koli	Fd
	10	Kristiina	Fd
		Alcamo	I

(90.10)		B. go Val Sugana	I
		M. Argentario	I
		Modica	I
		Mondovi	I
		M. Celentone	I
		M. Creo	I
		M. Vergine	I
		Potenza	I
	60	Divis	U
90.20		Vestjylland	D
	100	Langenberg	G
		Oslo	No
		Parede	P
90.30		Orleans (A.F.N.)	F
	0.5	Bad Reichenhall	G
	50	Verdun (B.F.N.)	G
	25	Weinbiet	G
		Jerusalem	Is
		M. Conero	I
		Piasa	I
		Sassari	I
		Spoleto	I
	1	Fadara	Sd
	60	N. Hessary Tor	U
	120	Sandale	U
90.50	60	Grünten	G
		Fucino	I
		M. Scuro	I
		M. Serra	I
		Noto	I
		Trapani	I
	120	Sutton Coldfield	U
90.60	2	Kiel	G
		Borgo, Val di Taro	I
		Domodossola	I
		Milan	I
		Sondrio	I
		Bjerkreim	No
90.63	0.1	Stubnerkogel	A
90.65	100	Teutoburger Wald	G
90.70	10	Tampere	Fd
		M. Bignone	I
		M. Serpeddi	I
		Paganella	I
		Pomarico	I
		Terminillo	I
	60	Pontop Pike	U
	60	Rowridge	U
90.80		Copenhagen	D
90.85	15	Bamberg	G
90.90	5	Hannover	G
	9	Hohe Linie	G
	2.5	Koblenz	G
	5	Münster	G
	100	Stuttgart	G
		Bologna	I
		M. Favone	I
		Pantelleria	I
		Gulen	No
	12	Steinkjer	No
		Attinghausen	Sd
	60	Blaen-Plwyf	U
	60	Meldrum	U
91.00	15	Imatra	Fd
		Marlow	G
		Raum Jessen	G
91.10		Mulhouse	F
		Ascoli Piceno	I
		Bellagio	I
		Bordighera	I
		Colle Visentin	I
		Candoglia	I
		Maranza	I
		Martina Franca	I
		Polcevera	I
		Sulmona	I
	6	Llangollen	U
91.20		Schoeckl	A
	55	Biedenkopf	G
	0.5	Geislingen	G
	9	Hohenpeissenberg	G

(91.20)	10	Oldenburg	G
	19	Potzberg	G
	25	Wittlich-Hegau	G
		La Dole	Sd
		Ovc	Sd
91.30		Marseilles	F
		Alleghe	I
		Carrara	I
		Naples	I
		P. Badde Urbara	I
		Trieste	I
	120	Wrotham	U
91.50	50	Caen	F
		Toulouse	F
	60	Brodjacklriegel	G
	3	Bungsberg	G
	40	Heidelberg	G
	0.25	Kleve	G
	0.5	Ulm-Wilhemsburg	G
		Brisighella	I
		Gardone	
		Val Trompia	I
		M. Sambuco	I
		Rovereto	I
		Ladir	Sd
	1	St. Moritz	Sd
	1	Orebro	Sw
		Ostersund	Sw
	120	Holme Moss	U
91.53	2	Bonn (B.F.N.)	G
91.60	30	Kuopio	Fd
		Stulpe	G
91.70		Aarhus	D*
		Cascia	I
		Garfagnana	I
		Lagonegro	I
		Mione	I
		Premeno	I
		Rome	I
91.80	0.5	Bremerhaven	G
	60	Ochsenkopf	G
	12	Raichberg	G
	6	Eifel	G
	0.5	Siegen	G
	15	Hoogezand	Ne
		Stord	No
	2	Llanddona	U
	6	Rosemarkie	U
91.85	0.5	Munich-Freimann	G
91.90	40	Helsinki	Fd
		Genoa	I
		Marca Pusteria	I
		M. St. Angelo	I
		M. Soro	I
		Stazzona	I
		Teramo	I
	120	Tacolneston	U
92.00		Tel Aviv	Is
92.10		Patscherkofel	A
	0.25	Berlin	G
	5	Hamburg	G
		Alcamo	I
		B. go Val Sugana	I
		M. Argentario	I
		M. Celentono	I
		Modica	I
		M. Vergine	I
		Potenza	I
		Turin	I
		Rabat	M
		Goteborg	Sw
	120	Kirk o' Shotts	U
	120	Wenvoe	U
92.13	55	Feldberg-Taunus	G
92.20		Lille	F
	10	Jyväskylä	Fd
92.30		Como	I
		Asiago	I

(Continued on page 45)

Abbreviations: A, Austria; B, Belgium; C, Cyprus; D, Denmark; Fd, Finland; F, France; G, Germany East; G, Germany West; H, Hungary; Is, Israel; I, Italy; L, Luxembourg; M, Morocco; Ne, Netherlands; No, Norway; P, Poland; Pl, Portugal; R, Rumania; S, Spain; Sw, Sweden; Sd, Switzerland; U, United Kingdom; V, Vatican City; Y, Yugoslavia; A.F.N., American Forces Network; B.F.N., British Forces Network.

Vortexion quality equipment

Model W.V.B.

Our specialised MONITOR HEAD MODEL W.V.B. has an additional head and amplifier which enables this recorder to perform a number of useful functions. The most important of these is to monitor the recorded tape a fraction of a second after it is made, and if necessary compare it by throwing a switch, with the signal before it is recorded. This allows the recording engineer to make certain that he has made a first class recording before the artists leave the studio, without the necessity of waiting while another run through is made.

Additional items may be recorded one on top of another while listening to the first, since a switch is provided for the erase, and the bias, which also acts as a partial erase, can be lowered slightly, and its new value checked on the meter. In a similar manner, the original signal may be fed back and recorded, resulting in an echo, the time constant of which is controlled by the speed of the tape and the distance apart of the heads.

VORTEXION RECORDERS use a synchronous capstan motor to ensure accurate recording and play back speed.

Many years of steady development have enabled us to still further improve the Vortexion W.V.A. and W.V.B. recorders.

All components which could contribute to noise or reliability are carefully measured and selected individually before incorporation, resulting in an exceedingly low background noise and distortion with frequency response within ±1.5 db 50-10,000 c/s and ±3 db 40-12,000 c/s at 7½" per second.

★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.

★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.

★ The 0.5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

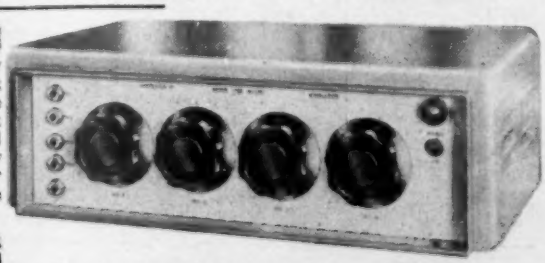
★ The power output is 4 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.

★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

FOUR CHANNEL ELECTRONIC MIXER

This is a studio quality electronic mixer suitable for any climate. The controls are hermetically sealed, and great care and selection of components to make certain reliable low noise operation, and individual screens prevent break through. The built-in power transformer is screened and potted, and all the microphone transformers are individually potted in selected heavy gauge mu-metal boxes. Front or rear inputs and outputs may be obtained to order. The normal output is .5 volt.



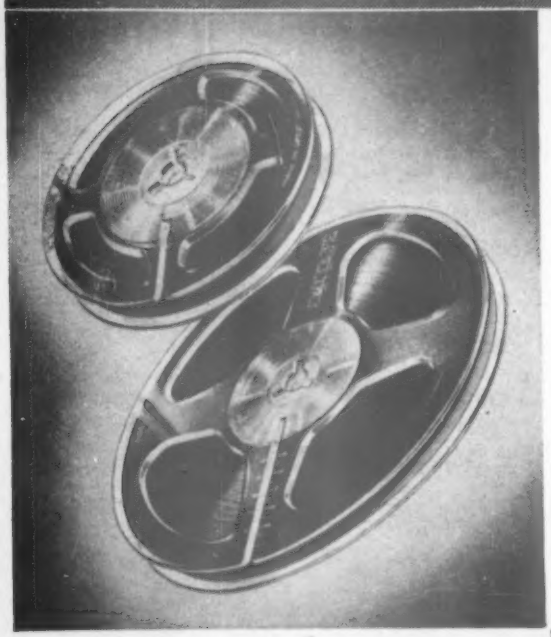
The 3-CHANNEL MIXER and PEAK PROGRAMME METER is similar to the above but has the additional meter fitted calibrated in 2 db steps from −20 db to +12 relative to l.m.w.—600 ohm. The meter is fed by the full P.P.M. 1 second time delay circuit which includes a stabiliser valve, to ensure accurate gain and calibration. The standard output is screened primary and l.m.w.—600 ohm balanced or unbalanced by switch. Inputs and outputs may be at the front or rear, and rack panel mounting is available at the same price.

Full details and prices of the above on request

VORTEXION LIMITED, 257 263 The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 **Telegrams: "Vortexion, Wimble, London."**

Emitape



the magnetic recording tape with the highest technical standards

* High sensitivity
* Low noise level
* Low 'print through' factor
* Anti-static
* Freedom from curl and stretch

"88" GENERAL PURPOSE **"99" LONG PLAY**

Type No.	Title	Size	Length approx.	Price in EMICASE	Price without EMICASE
88/3	"Message"	3" dia.	175'	—	7 6
99/3		3" dia.	250'	—	9 6
88/3N		3½" dia.	175'	—	7 6
99/3N		3½" dia.	250'	—	9 6
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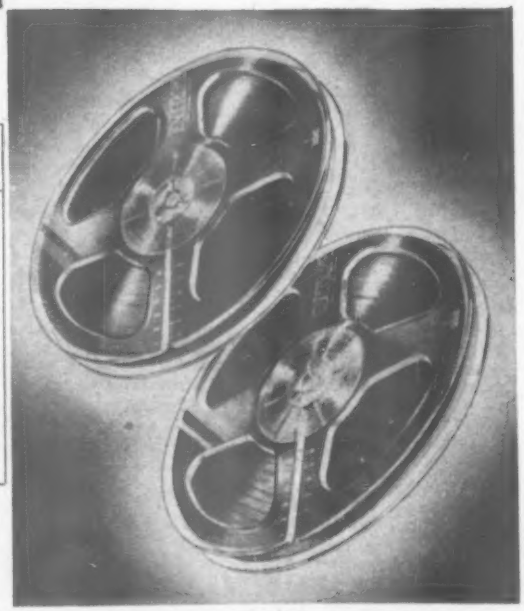

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EUROPEAN BAND II STATIONS (Continued)

(92.30)		Cima Penegal	I
		Gorizia	I
		M. Conero	I
		Sassari	I
		Spoleto	I
	60	Divis	U
92.40		Schmittenhöhe	A
	0.5	Göttingen	G
	18	Waldburg	G
		Horby	Sw
		Stockholm	Sw
92.50	0.8	Baden-Baden	G
		Cortina	I
		Fucino	I
		Mondovi	I
		M. Scuro	I
		Noto	I
		San Pellegrino	I
		Trapani	I
		Valle S. Giacomo	I
		Parco	Pl
	60	N. Hessary Tor	U
	120	Sandale	U
92.60		St. Germain-en-Laye (A.F.N.)	F
		Stülpen	G
92.67	0.1	Buchen-Walldürn	G
92.70		Lyon Mont-Pilat	F
	50	Aalen	G
	0.07	Hochrhein	G
		M. Serpeddi	I
		Paganella	I
		Pomarico	I
	120	Sutton Coldfield	U
92.72	0.05	Wertheim	G
92.80		Kami	Fd
		Berlin	G
		Hälsingborg	Sw
	6	Douglas	U
92.90		M. Creo	I
		M. Favone	I
		M. Serra	I
		Pantelleria	I
		Villar Perosa	I
		Madrid	S
	60	Pontop Pike	U
	60	Rowridge	U
		Maribor	Y
93.00	1	Klagenfurt	A
	10	Pyramidenkogel	A
	50	Bourges-Neuvy	F
	0.3	Betzdorf/Westerw	G
	15	Flensburg	G
	6	Herford (B.F.N.)	G
	60	Hornisgrinde/Schw	G
	0.5	Kreuzeck	G
	0.5	Passau	G
	1	Leuk-Fesche'	Sd
	0.5	Schulz	Sd
		Borlänge	Sw
93.10	25	Vaasa	Fd
		Ascoli Piceno	I
		Colle Visentin	I
		Martina Franca	I
		Sulmona	I
	60	Blaen-Plwyf	U
	60	Meldrum	U
93.20	0.3	Stuttgart	G
		Bellagio	I
		Candoglia	I
		Courmayeur	I
		La Spezia	I
		M. Bignone	I
		Malcesine	I
93.30	1	Plunder	A
		Aalborg	D
		Bordeaux	F
	150	Metz-Luttange	F
		Halle	G
	2	Dannenburg	G
	0.5	Hardberg	G
	0.03	Mainz	G
	2.5	Hoher Meissner	G
	15	Norden-Osterloog	G
		Tel Aviv	Is
		Allegho	I
		Naples	I
		P. Badde Urbara	I
		Voss	No
	6	Llangollen,	U
		Vatican City	V
93.40	0.5	Cologne	G
93.50		Aosta	I
		Brisighella	I
		Carrara	I
		M. Sambuco	I
		Ploso	I
		Sestriere	I
		Trieste	I
	15	Mierlo	Ne
		Tryvasshogda	No
		Norrköping	Sw
	120	Wrotham	U
93.60	10	Berlin	G
	25	Haardtkopf	G
	15	Heide	G
	3	Osnabrück	G
	100	Waldenburg	G
		Tel Aviv	Is
		Bremanger	No
		Varberg	Sw
93.65	100	Wendelstein	G
93.70	10	Tampere	Fd
		Cascia	I
		Garfagnana	I
		Milan	I
		Porretta Terme	I
		Rome	I
		Rovereto	I
		Val Gardena	I
	120	Holme Moss	U
93.90	18	Dillberg	G
	5	Hannover	G
	0.25	Heidelberg (A.F.N.)	G
	15	Nordhelle	G
		Bagni di Lucca	I
		Bologna	I
		M. St. Angelo	I
		M. Soro	I
		Pieve di Cadore	I
		Val Venosta	I
		Scheveningen	Ne
	1	Brigue	Sd
	1.4	Zeneggen	Sd
		Gavle	Sw
94.00		Toul (A.F.N.)	F
		Ylivieska	Fd
		Inselberg	G
	2	Llanddona	U
	1	Penmon	U
	6	Rosemarkie	U
94.10	0.2	Augsburg	G
		Casentino	I
		M. Faito	I
		Potenza	I
	120	Tacolneston	U
		Ljubljana	Y
94.15	2	Kiel	G
94.20	18	Pfaffenberg	G
	100	Teutoburger Wald	G
		M. Penice	I
	1	Les Ordons	Sd
94.30	50	St. Pölten	A
	10	Turku	Fd
		Alcamo	I
		M. Argentario	I
		Catanzaro	I
		Lunigiana	I
		Modica	I
		Ogliastro	I
		Pescara	I
		S. Marcello Pistoiese	I
		Marca Pusteria	I
		Tel Aviv	Is
		Lisbon	Pl
	120	Kirk o' Shotts	U
	120	Wenvoe	U
94.40		B. go Val Sugana	I
		M. Celentone	I
94.45	15	Bamberg	G
94.50		Bornholm	D
	2.5	Koblenz	G
	5	Münster	G
	100	Stuttgart	G
		Asiago	I
		M. Beigua	I
		Roseto Capo Spulico	I
		Sassari	I
		Terminillo	I
		Tolmezzo	I
	60	Divis	U
		Orknoys	U
94.60		Phalsbourg (A.F.N.)	F
	40	Helsinki	Fd
	6	Kristiina	Fd
		Brocken (Harz)	G
		Borås	Sw
94.70		Cortina	I
		M. Caccia	I
		M. Lauro	I
		M. Nerone	I
		Mione	I
		Stazzona	I
	120	Sandale	U
94.80	1	Salzburg	A
	1	Gotschnagrat	Sd
	1.5	Sooi	Sd
94.90	10	Feldberg (A.F.N.)	G
		Genoa	I
		Lagonegro	I
		Palermo	I
		Plateau Rosa	I
		Sezze	I
		Terni	I
(94.90)		Villar Perosa	I
	15	Hoogezand	Ne
95.00		Strasbourg	F
95.10		Sonderjylland	D
		Agordo	I
		Bolzano	I
		Campo Imperatore	I
		Golfo Salerno	I
		S. Giuliana	I
		S. Lucia	I
		Udine	I
		Valle Isarco	I
	4	Hulsberg	Ne
	60	Bantiger	Sd
	0.5	Schulz	Sd
		Tarasp	Sd
95.20	25	Vaasa	Fd
		Görlitz	G
		Rheinsberg	G
		Borgo, Val di Taro	I
		Domodossola	I
		Sondrio	I
95.30		Benevento	I
		Como	I
		Gambarie	I
		M. Limbara	I
		S. Cerbone	I
95.37	55	Biedenkopf	G
95.40	10	Schockl	A
		Brussels	B
		Marseilles	F
	100	Oldenburg	G
	19	Potzberg	G
	60	Santis	Sd
95.50	30	Lahti	Fd
		Brisighella	I
		Campo Catino	I
		Colle Visentin	I
		Gardone Val Trompia	I
		S. Antioco	I
95.52	50	Caen	F
95.60		C. Spartivento	I
		Maranza	I
		Turin	I
95.70	2.5	Blausen	G
	3	Bungsberg	G
	100	Langenberg	G
		M. Peglia	I
		Madonna di Campiglio	I
		Porretta Terme	I
		S. Sofia	I
		Val Gardena	I
		Hälsingborg	Sw
		Vasteras	Sw
95.80	30	Vienna-Kahlenberg	A
		Nicosia (B.F.N.)	C
		Dijon	F
	10	Savonlinna	Fd
95.90		Aarhus	D
		Bordighera	I
		Crotone	I
		M. Cammarata	I
		Mugello	I
		Polcevera	I
		Rovereto	I
		San Pellegrino	I
96.00	18	Linz	G
		Munich (Ismanning)	G
	12	Raichberg	G
	10	Schaumberg	G
	100	Torfhaus (Harz)	G
	1.5	Würzburg	G
	15	Ijmuiden	Ne
	0.75	Gstaad	Sd
		Ladir	Sd
96.05	60	Ochsenkop	G
96.10	20	Paris	F
		Kotka	Fd
		Bologna	I
		Carrara	I
		Casentino	I
		M. Faito	I
		M. Padric	I
		Premeno	I
		Valle S. Giacomo	I
		Val Venosta	I
96.20		Breda	Ne
96.30	50	Hamburg	G
		Catanzaro	I
		Mandovi	I
		M. Serpeddi	I
		Pescara	I
		Trieste	I
		M. Morello	Sd
	15	Göteborg	Sw
		Vatican City	V
96.40		Leipzig	G
96.50		Copenhagen	D
		Asiago	I
		Bagni di Lucca	I
		Cima Penegal	I
		M. Beigua	I
		Malcesine	I
(96.50)		Roseto Capo Spulico†	I
		Tolmezzo	I
96.60	15	Bützelberg	G
	15	Nordhelle	G
		La Borra	Sd
	1	Stockholm	Sw
96.70	18	Rovaniemi	Fd
		Marlow	G
		Bellagio	I
		Candoglia	I
		Cortina	I
		M. Caccia	I
		M. Lauro	I
		M. Nerone	I
96.75	3	Berlin*	G
96.90		Nancy	F
	18	Bremen	G
	0.25	Werit	G
	18	Wolfsheim	G
		Lunigiana	I
		S. Marcello Pistoiese	I
		Sezze	I
		Palermo	I
		Plateau Rosa	I
		Terni	I
		Villa Perosa	I
	1.5	Celerina	Sd
		St. Anton	Sd
		Sundsvall	Sw
97.00		Burg	G
97.10		Agordo	I
		Bolzano	I
		Campo Imperatore	I
		Golfo Salerno	I
		S. Giuliana	I
		S. Lucia	I
		Udine	I
		Valle Isarco	I
97.20		Hengelo	Ne
	50	Markelo	Ne
	1	Gotschnagrat	Sd
	0.7	Niederhorn	Sd
	1	Sooi	Sd
97.23	0.1	Stubnerkogel	A
97.30		Dreux (A.F.N.)	F
	3	Pori	Fd
		Helpterberg	G
		Benevento	I
		Campo Catino	I
		Gambarie	I
		S. Cerbone	I
		P. Badde Urbara	I
97.40		Sonnwendstein	A
		M. Penice	I
97.50		M. Bignone	I
		Hulsberg	Ne
	60	Uetliberg	Sd
97.60	10	Pietarsaari	Fd
		Sonneberg	G
		Aosta	I
		C. Spartivento	I
		Sestriere	I
		Lyngdal	No
97.70		M. Peglia	I
		Madonna di Campiglio	I
		Pieve di Cadore	I
		Porretta Terme	I
		S. Antioco	I
		S. Sofia	I
		Val Gardena	I
		Koper	Y
97.75	3	Kreuzberg	G
97.80		Kanzelhohe	A
	10	Pyramidenkoge	A
	0.5	Flensburg	G
	18	Linz	G
	1	Les Ordons	Sd
97.85	1.25	Hannover	G
97.90		Crotone	I
		M. Cammarata	I
		Mugello	I
98.10		Bordeaux	F
		Casentino	I
		Gorizia	I
		M. Faito	I
		M. Padric	I
		Ploso	I
		Terminillo	I
98.20	30	Turku	Fd
		Berlin	G
		Turin	I
98.30		Catanzaro	I
		Como	I
		Ogliastro	I
		Pescara	I
		Hengelo	Ne
	50	Markelo	Ne
98.40	12	Feldberg	G
	15	Pinneberg (B.F.N.)	G
		Västerås	Sw
98.45	8	Aachen	G

*French Forces.
†Canadian Forces.

EUROPEAN BAND II STATIONS (Continued)

98.50		Bagni di Lucca	I	(98.90)		Sezze	I	(92.20)		Breda	Ne	99.60	100	Teutoburger Wald	G
		Domodossola	I			Terni	I	99.30	1	Linz	A			C. Spartivento	I
		Malcesine	I	99.00		Salzburg	A			Bornhaim	D		0.7	Niederhorn	Sd
		Roseto Capo Spulico	I		15	Hannover (B.F.N.)	G		80	Drachenberg (B.F.N.)	G	99.70	10	Kokkola	Fd
		Coimbra	Pl			Basel	Sd		18	Wolfsheim	G			Aosta	I
98.70	18	Dillberg	G			Gempen	Sd			Benevento	I			M. Paglia	I
	15	Nordehhile	G	99.05	1	Berlin (B.F.N.)	G			Gambarie	I			Madonna di Campiglio	I
		Gardone Val Trompia	I	99.10		Agordo	I			M. Limbara	I			Pieve di Cadore	I
		M. Caccia	I			Campo Imperatore	I			S. Cerbone	I			S. Sofia	I
		M. Lauro	I			Golfo Salerno	I		1	Fadara	Sd			Sestriere	I
		M. Nerone	I			Lunigiana	I			Ravoire	Sd			Udine	I
		Val Venosta	I			Plateau Rosa	I	99.40		Kajaani	Fd	99.80		Laon (A.F.N.)	F
		Gavle	Sw			Premeno	I		3	Pori	Fd	99.90	30	Vienna-Kahlenberg	A
	3	Malmö	Sw			S. Giuliana	I			La Spezia	I			Sonderjylland	D
99.90	1.5	Saarbrücken	G			S. Lucia	I			Milan	I		100	Torfhaus (Harz	G
		Cima Penegal	I			San Pellegrino	I	99.50		Karl Marx Stadt	G			Crotone	I
		M. Beigua	I			Tolmezzo	I			Bolzano	I			M. Cammarata	I
		Palermo	I			Valle S. Giacomo	I			Campo Catino	I			M. Penice	I
		S. Marcello Pistoiese	I			Valle Isarco	I			M. Padrio	I			Mugello	I
				99.20		Bucharest	R			S. Antioco	I		15	Mierlo	Ne
						Vestjylland	D								

JANUARY MEETINGS

Tickets are required for some meetings; readers are advised therefore to communicate with the secretary of the society concerned.

LONDON

5th. I.E.E.—"The application of transistors to line communication equipment" by H. T. Prior, D. J. R. Chapman and A. A. M. Whithead at 5.30 at Savoy Place, W.C.2.

9th. Television Society.—"A television link with America?", a discuss.on at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

9th. Radar & Electronics Association, Student Section.—"Television wire broadcasting" by K. A. Russell (British Relay Wireless) at 7.0 at the Norwood Technical College, Knight's Hill, S.E.27.

13th. I.E.E.—Discussion on "Education and training from the student's point of view" opened by two members of the London Graduate and Student Section at 6.30 at Savoy Place, W.C.2.

14th. Society of Instrument Technology.—Symposium on data storage media at 6.0 at Manson House, Portland Place, W.1.

16th. Institute of Navigation.—"Blind landing problems" by W. J. Charnley (Blind Landing Experimental Unit, R.A.E.) at 5.15 at The Royal Geographical Society, 1 Kensington Gore, S.W.7.

16th. B.S.R.A.—"Some further developments in loudspeakers" by A. R. Neve at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

19th. I.E.E.—"High-current-density thermionic emitters" by A. H. W. Beck at 5.30 at Savoy Place, W.C.2.

20th. I.E.E.—Discussion on "D.C. amplifiers" opened by K. Kandiah at 5.30 at Savoy Place, W.C.2.

21st. I.E.E.—"Dielectric materials—trends and prospects" by C. G. Garton at 5.30 at Savoy Place, W.C.2.

21st. Royal Society of Arts.—"Technical education: a prognosis" by the Right Hon. Lord Nathan (president, Association of Technical Institutions) at 2.30 at John Adam Street, W.C.2.

22nd. Television Society.—Fleming Memorial Lecture, "Modern optics in relation to television" by G. H. Cook (Taylor, Taylor & Hobson), at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

26th. I.E.E.—Faraday Lecture on "Automation" by Dr. H. A. Thomas at 6.0 at the Royal Festival Hall.

26th. Radar and Electronics Association.—"Zeta: nuclear power and fusion" by Dr. D. W. Fry, deputy director, Harwell Atomic Energy Establishment, at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

27th. Society of Instrument Technology.—Symposium on flow measurement at 6.0 at Manson House, Portland Place, W.1.

28th. Brit.I.R.E.—"Speech recognition and the phonetic typewriter" by Professor D. B. Fry and P. Denes at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

29th-30th. I.E.E.—Convention on long-distance transmission by waveguide at Savoy Place, W.C.2. (All wishing to attend must register.)

30th. Women's Engineering Society.—"Some uses of electron beams in metallurgy" by Mrs. I. H. Hardwich at 7.0 at Hope House, 45 Great Peter Street, S.W.1.

BOURNEMOUTH

21st. I.E.E.—"Domestic high-fidelity reproduction" by J. Moir at 6.30 at the Grand Hotel.

BRISTOL

29th. Brit.I.R.E.—"Recent developments in printed and potted circuits" by H. G. Manfield at 7.0 at the School of Management Studies, Unity Street.

CARDIFF

14th. Brit.I.R.E.—"Computer control of machine tools" by H. Ogden at 6.30 at the College of Advanced Technology.

26th. I.E.E.—"A transatlantic telephone cable" by Sir Gordon Radley at 6.0 at the South Wales Institute of Engineers, Park Place.

EDINBURGH

7th. I.E.E.—"A new cathode-ray tube for monochrome and colour television" by Dr. D. Gabor, P. R. Stuart and P. G. Kalman at 7.0 at the Carlton Hotel, North Bridge.

GLASGOW

6th. I.E.E.—"A new cathode-ray tube for monochrome and colour television" by Dr. D. Gabor, P. R. Stuart and P. G. Kalman at 7.0 at Royal College of Science and Technology, George Street.

GRANGEMOUTH

29th. Society of Instrument Technology.—"Electronic weighing" by K. J. Railler at 7.0 at the Leapark Hotel.

MALVERN

12th. I.E.E.—"Electrostatic Loudspeakers" by P. J. Walker at 7.30 at the Winter Gardens.

29th. Brit.I.R.E.—"Industrial and underwater television" by B. V. Somes-Charlton at 7.0 at the Winter Gardens.

MANCHESTER

20th. I.E.E.—"The atomic clock" by Dr. L. Essen at 6.15 at the Engineers' Club, Albert Square.

NEWCASTLE

12th. Brit.I.R.E.—"The design and construction of an electronic digital computer" by R. W. Walker at 6.0 at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road.

19th. Institution of Production Engineers.—"Electronic computers and the production engineer" by P. V. Ellis at 7.0 at the Rutherford College of Technology, Northumberland Road.

PORTSMOUTH

7th. I.E.E.—"Ultrasonics in industry" by C. F. Brockelsby at 6.30 at C.E.G.B. Offices, 111, High Street.

STOKE-ON-TRENT

12th. Institution of Production Engineers.—"Electronic computer control of machine tools" by H. Ogden at 7.30 at the Grand Hotel, Hanley.

23rd. Association of Supervising Electrical Engineers.—"Electronics" by F. H. Fryer at 7.30 at the Grand Hotel, Hanley.

WEYMOUTH

30th. I.E.E.—"Radio observations on the artificial satellites" by Dr. R. L. F. Boyd at 6.30 at the South Dorset Technical College.

WOLVERHAMPTON

21st. Brit.I.R.E. — "Learning machines" by P. Huggins at 7.15 at the Wolverhampton and Staffordshire College of Technology, Wulfruna Street.

EXHIBITIONS AND CONFERENCES

UNITED KINGDOM

Physical Society's Exhibition, Royal Horticultural Society's Halls, Victoria, London, S.W.1 ..... Jan. 19-22
(Physical Society, 1 Lowther Gardens, Prince Consort Road, London, S.W.7.)

Convention on Long-Distance Transmission by Waveguide, Savoy Place, London, W.C.2 ..... Jan. 29-30
(I.E.E., Savoy Place, London, W.C.2.)

Television Equipment Exhibition, Royal Hotel, London, W.C.1.... Mar. 3-5
(Television Society, 166 Shaftesbury Avenue, London, W.C.2.)

Electrical Engineers' Exhibition, Earls Court, London, S.W.5..... Mar. 17-21
(P. A. Thorogood, Museum House, Museum Street, London, W.C.1.)

Audio Fair, Russell Hotel, Russell Square, London, W.C.1..... Apr. 2-5
(Audio Fairs Ltd., 42 Manchester Street, London, W.1.)

Radio and Electronic Component Show, Grosvenor House and Park Lane House, Park Lane, London, W.1 ..... Apr. 6-9
(R.E.C.M.F., 21 Tothill Street, London, S.W.1.)

International Instruments Show, Instrumentation Centre, Park Lane, London, W.1..... Apr. 6-10
(B. & K. Laboratories, 4 Tilney Street, London, W.1)

Engineering, Marine, Welding and Nuclear Energy Exhibition, Olympia, London, W.14 ..... Apr. 16-30
(F. W. Bridges & Sons, Grand Buildings, Trafalgar Square, London, W.C.2.)

International Convention and Exhibition on Transistors, Earls Court, London, S.W.5 ..... May 21-27
(I.E.E., Savoy Place, London, W.C.2.)

International Plastics Exhibition and Convention, Olympia, London, W.14 June 17-27
("British Plastics," Dorset House, Stamford Street, London, S.E.1.)

British Computer Society's Conference, Cambridge..... June 22-25
(British Computer Society, Finsbury Court, Finsbury Pavement, London, E.C.2.)

Convention on Techniques and Applications of Television, Cavendish Laboratory, Cambridge ..... July 1-5
(Brit. I.R.E., 9 Bedford Square, London, W.C.1.)

National Radio and Television Show, Earls Court, London, W.5 Aug. 26-Sept. 5
(R.I.C., 59 Russell Square, London, W.C.1.)

Farnborough Air Show.....Sept. 8-14
(Society of British Aircraft Constructors, 29 King Street, London, S.W.1.)

Radio Hobbies Exhibition, Royal Horticultural Hall, London, S.W.1 Nov. 25-28
(P. A. Thorogood, Museum House, Museum Street, London, W.C.1)

OVERSEAS

National Symposium on Reliability and Quality Control in Electronics, Philadelphia ..... Jan. 12-14
(R. Brewer, G.E.C. Research Laboratories, Wembley, Middx.)

Paris Components Show (Salon International de la Pièce Détachée Electronique)
(S.N.I.R., 23 rue de Lubeck, Paris 16.) Feb. 20-24

Stockholm Electronics Exhibition ..... Mar. 21-30
(Industrial & Trade Fairs, Drury House, Russell Street, London, W.C.2.)

I.R.E. National Convention, New York..... Mar. 23-26
(E. K. Gannett, I.R.E., 1 East 79th Street, New York 21, N.Y., U.S.A.)

Symposium of Millimetre Waves, New York..... Mar. 31-Apr. 2
(Polytechnic Institute of Brooklyn, 55 Johnson Street, Brooklyn 1, N.Y., U.S.A.)

Interdisciplinary Conference on Self-Organizing Systems, Chicago May 5-6
(Scott H. Cameron, Armour Research Foundation, Chicago 16, U.S.A.)

British Trade Fair, Lisbon, Portugal..... May 29-June 14
(British Overseas Fairs Ltd., 21 Tothill Street, London, S.W.1.)

International Conference on Information Processing, Paris..... June 15-20
(B.C.A.C. Group B, c/o I.E.E., Savoy Place, London, W.C.2.)

I.R.E. International Symposium on Circuit and Information Theory, Los Angeles ..... June 16-18
(Richard A. Epstein, Jet Propulsion Laboratory, Pasadena, California, U.S.A.)

International Chemistry Conference and Exhibition, Paris..... June 16-30
(Conférence Internationale des Arts Chimiques, 28 rue Saint-Dominique, Paris 7.)

International Congress on Acoustics, Stuttgart ..... Sept. 1-8
(Dr. Ing. E. Zwicker, Breitscheidstr. 3, Stuttgart.)

Further details of the exhibitions and conferences are obtainable from the addresses in brackets.

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RANDOM RADIATIONS

By "DIALLIST"

Printed Circuits

THANKS to the many letters that readers were kind enough to send me and to conversations with dealers and servicemen, I've been able to compile quite a dossier on the subject of printed circuits. Two points of importance emerge right away. The first is that the printed panel is perfectly sound in theory and can be made so in practice. The second is that printed panels used in some receivers are not always to be depended upon. Let's begin with the first point. Printed circuitry has proved to the hilt that if it is made up skilfully and from high-grade materials it can be entirely trustworthy: otherwise it wouldn't be so widely used in radar equipment as it is nowadays, or in guided missiles, artificial satellites and other apparatus in which reliability is a must. In the United States "*everything* electronic," as one reader puts it, "which can be printed is printed."

Special Short Courses?

Some sound and television setmakers provide their own printed panels. A member of one well-known firm has sent me one of theirs, which is a beautiful example of good design and good workmanship applied to excellent materials. He tells me that his service department reports that faults in receivers using such panels are appreciably fewer in number than they were when conventional wiring was in use. Some dealers, I think, dislike printed panels because with them it's not always easy to isolate this or that for quick tests. Some, again, are too ready to diagnose that there is a fault in the printed connection when anything goes wrong. I've heard of three different cases in which sets were returned to manufacturers as suffering from some such trouble only for it to be discovered on testing that in each one of them the cause of the breakdown was, in fact, a "dud" valve! It would be a good idea if setmakers ran short courses for service department managers and servicemen on trouble-hunting in printed circuits. Perhaps some of them are already doing so.

Quality and Design

And now for the other side of the picture, for everything in the garden is still far from being lovely. I'm told that not all setmakers produce their own printed panels and that, in addition to many firms of good repute, there are cheapjack firms ready to supply them at very low prices. Some of these concerns use poor materials and their workmanship is shoddy. Any maker who uses their products with the idea of lowering manufacturing costs is taking a big risk, for a few disgruntled customers who air their grievances to all and sundry can soon cancel out the effects of much expensive advertising. There's no doubt that printed panels are here to stay and it's up to setmakers to see that they don't get a bad name because of the indifferent quality of some of them. One reader raises an interesting point I hadn't thought of. Some makers use vertically-mounted panels with resistors, capacitors and so on fitted at right angles to them. As he says, this increases the leverage and it may possibly be one of the causes of those hairline cracks in conducting paths of which not a few people complain.

Out of Print!

From Rotherham comes a letter from a home constructor which suggests yet another possibility to be guarded against. He intended to make up a rather expensive piece of apparatus from a published description. He acquired the parts one by one over a period and needed only the printed panel in order to get going at last. On sending for it, he learned that it was no longer available. To use his own words, "it was quite literally out of print." Setmakers will have to bear that sort of thing in mind. Most ordinary folk, I suppose, expect a television set to keep going for a good five years or so and a sound receiver for much longer than that. It will certainly be up to makers to keep stocks of printed panels for their various models for a good few years after they make their first appearance. Anyone who sent in a set for repairs after, say, three or four years and found that nothing could be done because it was impossible to replace a faulty panel would most certainly not be amused!

American Tube Rebuilding

A RECENT issue of *Wireless Trader* contained a most interesting letter on the position of c.r.t. rebuilding firms in America. It was from W. C. Gase, general manager of the G. & S. Electronic Corporation, of Toledo, Ohio, one of the 65 firms who now undertake the work on the other side of the Herring Pond. In 1957 60% of all replaced c.r.t.s were rebuilds.

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TELEVISION ENGINEERING VOLUME IV: General Circuit Techniques. S. W. Amos, B.Sc.(Hons.), A.M.I.E.E., and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E.	35/-	36/2
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The 1958 figure is expected to rise to 70% and, if so, the year's total of rebuilt tubes will be over 12,000,000. The method used is similar to that employed by at least one company over here. Each worn-out tube is opened and completely washed out, so that nothing remains of its old self but the glass bulb. When the job is finished the customer obtains what is to all intents and purposes a new tube, and this carries a twelve months' guarantee, in fact it is treated as such by the government who levy an excise on it. An important point is that all the major American valve manufacturers co-operate fully with the rebuilders, who are then able to buy from them all the parts and materials required—a very sound state of affairs from the public's point of view. The rebuilders require a dud tube for each rebuild supplied to a dealer.

The Amazing Transistor

WHAT enormous strides have been made in the making of transistors both in this country and in America. When they first made their shy appearance a few years ago they were tiny things, usable at low frequencies only, not able to handle more than a few milliwatts and not very reliable. To-day, transistors are very different things. There are types which will work at 1,000 Mc/s and others have been developed which can handle hundreds of watts at audio frequencies. Perhaps most important of all, improved design and manufacturing processes now turn out transistors so reliable that it is claimed that there is no reason why they should not work continuously for a century or more.

Can You Beat This?

Talking about long-service life reminds me that I heard the other day from a Stockport reader who tells me of an extraordinary experience that he has had with a 12-in c.r.t. in a TV set which he bought second-hand in February, 1953. The set is switched on at the start of Children's Hour and not switched off until bedtime every day, except when he and his family are away for their holiday. After 6,800 hours of use the emission had fallen off somewhat, so he boosted the heater voltage up gradually and maintained a good picture for a further 1,850 hours, when the heater burnt out. This gives a total of 8,650 hours of service, which is the longest TV tube life that I've ever heard of.

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D.C. Ratings			50~ Ratings			Max. Wkg. P.D. across contacts or to E.	Max. Test V., dry or recovered
V.	S.690, S.691: A.*	S.695: A.*	V.	S690, S.691: A.*	S.695: A.*		
12	3	3	12	3	6	250	1 KV. (Across contacts & to E.)
50	1	1	50	2	5		
110	0.25	0.5	110	1.5	4		
250	0.1	0.3	250	1.0	3		

*Peak, if the circuit has any peak-currents which exceed mean-current.

MECHANICAL DATA

List No.	Pre-travel allowable to user for longest life	Differential	Max. Over-travel, for longest life	Drive Force	Point of Drive, dim. from line of fixing crs.	Fixing crs.
S.690	0.015" (0.4 mm.)	0.018" to 0.031" (0.5 to 0.8 mm.)	0.015" (0.4 mm.)	> 10 ozs. (284 gms.)	⅝" (15.1 mm.)	2×8 B.A. clear (=0.090" ø) @ ⅜" crs. (9.5 mm.)
S.691	Do.	Do.	Do.	> 5 ozs. (142 gms.)	Do.	
S.695	0.030" (0.75 mm.)	0.025" to 0.040" (0.6-1 mm.)	0.025" (0.63 mm.)	>10 <4 oz. 113-284 gm.	1" (19 mm.)	2×6 B.A. clear @ ¾ crs.(17.5mm.

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By FREE GRID

Music Mucked Up

ONE of the biggest disadvantages of stereo is the necessity of using two loudspeakers spaced several feet apart. Even when the B.B.C. start their single-channel experiments we shall still require these spaced loudspeakers, and I have for a long time wondered if there was any way of using one loudspeaker.

A suggestion has been made to me as to how this might be done. But before I set to work to turn the idea into practical form, I should value your comments. This does not necessarily mean that I shall take any notice of them, for I can never forget that if Marconi had listened to the scientific pundits in 1901, he would not have tried to bridge the Atlantic by wireless.

Briefly, the idea is to use one loudspeaker having a motor-driven moving baffle so that the sound would be directed alternately to the left and the right. There would also be a simple commutator working in conjunction with the baffle so that the leads from the left- or right-hand channel of the amplifier would be connected to the LS in synchrony with the movements of the baffle.

Thus the sound would be radiated from the loudspeaker in two channels like the arms of the letter V. The sound from the left-hand channel would obviously strike the left-hand wall of the room, and be deflected towards the listener's left ear. In a similar manner, the sound from the right-hand channel would reach the listener's right ear.

There are obviously a lot of snags, since the two reflecting walls would be unlikely to be equal in the matter of sound absorption, and a certain amount of juggling with curtains and cushions would be necessary to even things up. No doubt the music would be mucked up to a certain extent, but according to many musical critics that happens with conventional stereo anyway. It could, at any rate, be a new experience as broadcasting itself was in 1922. Who would have dreamt that the ghastly gurglings of 2LO 36 years ago would develop into the dulcet tones of Wrotham 1958?

Destaticizing Shavers

NOWADAYS all-electric razors are suppressed to avoid interference with sound broadcasting and TV, but anybody who has had the same extensive experience of electric shavers as I have will know that some of them are better suppressed than others.

There is one particular make which I tried recently that was very troublesome although it contained all the usual suppressors. It occurred to me to try the effect of earthing the ironmongery of the comb and cutter, and this brought about such an amazing improvement that I wonder why its makers don't fit a three-pin plug.

I have often wondered why electric razors are fitted with two-pin plugs and no earth on the metal comb which is pressed to the face. It is true that all makes nowadays employ a non-metallic shaft to link the motor to the cutter, and so there is no danger of shock. But the metal casing of an electric fire is also isolated from the "live" parts and there is clearly no danger of shock while it remains in that condition. If it is

Experience of electric shavers.

desirable to earth the fire casing—as it certainly is—why not the metal comb of the shaver.

Many years ago I did get a nasty shock from an electric razor due to my absent-mindedly plunging it into hot water in the basin as I—and many others—used to do with our old cut-throats. It has made me so nervous that nowadays I use a low-voltage razor run from a bell-transformer fitted under the bathroom floorboards, with the lead from the secondary winding running to a wall socket.

Car Radio

Anybody who runs a car, be it a Rolls-Royce or the sort of contraption which takes me about on my lawful occasions, could not fail to be interested in the article on car radio design by F. Grimm in the November issue.

He seems to have covered every contingency, and I particularly admired the ingenuity displayed in getting rid of the last traces of ignition interference. He seemed, in fact, to be up to all the dodges except the one which I have always considered the only one to give 100 per cent results and that is to change over to a diesel engine.

Astral Advertising

I MUST confess to feeling very uneasy in my mind about the continued successful launching of satellites, which bodes no good to humanity. I am not, of course, thinking of the possibility of their being used as H-bomb carriers. There is no real cause for worry about that for if they do drop nuclear bombs on us all our worries will be at an end and if they are not going to do so then there is no need to worry.

No, it is a far more real and subtle menace that disturbs my peace of mind, for it cannot be long before the big advertisers, who sponsor sound and television programmes in Luxembourg, the U.S.A. and elsewhere, realize their potentialities, and we may find ourselves defenceless before a fierce fusillade of astral advertising.

It may well be asked how a sustained programme could be transmitted as the satellites, travelling at 18,000 m.p.h., would only be within reliable radio range of a target like London for a matter of two or three minutes. Unfortunately it would be only too easy by adopting the technique used by the Germans in 1918 to send radio instructions from Berlin to their submarines operating around the Spanish coast.

The procedure of the astral advertisers, reduced to its simplest terms, would be as follows. A base would be established in any convenient spot. The satellite, complete with solar-charged batteries, tape recorders and other necessary apparatus would be "orbited" from its base so that it passed over the desired target areas in its circummondial gyrations.

As the satellite passed over its base, the previously recorded programmes and propaganda would be radioed up to it; the reproducer on earth and the satellite-borne recorder producer rotating at such a speed that an hour's programme could be compressed into the few minutes that the man-made moon was within range. Supposing the HQ of the advertising company were in mid-Pacific. Obviously the satellite would be over London in less than an hour when it would re-radio its programme back to earth at the same high speed.

Obviously anybody below wanting to receive these programmes would have to equip himself with a recorder-reproducer capable of receiving the incoming high-speed recordings, which, after reception, would play them back at ordinary speed. It is useless to say that people will not equip themselves with this special apparatus. Provided it is skilfully advertised people will buy anything.

Is your amplifier good enough for broadcasting and recording ?

State here

yes

or

no ☐

If NO we will send you full particulars of our amplifiers.

If YES we will make sure we have your name on our mailing list for details of our new stereo amplifiers and future products.

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Leak amplifiers were the first in the world to be marketed with a distortion content as low as 0.1%, a claim received with incredulity in 1945 but which was subsequently confirmed by the National Physical Laboratory and has since become an accepted world-wide standard.

LEAK amplifiers are the choice of professional engineers such as the B.B.C. (over 500 delivered), the South African Broadcasting Corporation (600), ITV and many other Commonwealth and overseas broadcasting and TV systems, who use them for transmitting and/or monitoring (quality checking) the broadcasts to which you listen.

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From long experience and by extreme attention to design details during development work on the pre-production models, we enable our craftsmen to achieve a high output per man-hour. The labour costs thus saved offset the increased costs incurred for high-grade materials, components and finishes, and this, together with quantity production (made possible only by a world-wide market), explains how quality products may be sold at reasonable prices

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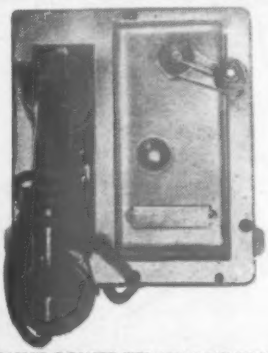
SHERRILL U.S.A. COMPASS, magnetic type, directional indicator. Complete with built-in variable horizon corrector, induced error corrector, variable course indicator, deviation calculator, etc., with provisions for internal lighting. Brand new. £3/10/- ea. P. & P. 2/-.



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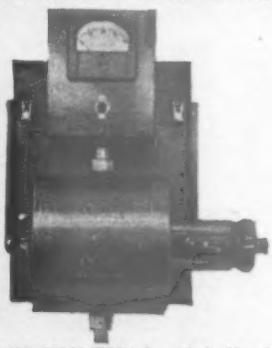
£3 Unit or £5/17/6 pr. Carr. 7/6. Master Units to take five extensions also available. £4 each.



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HIGH SPEED RELAY, Siemens, two bobbins, 1,000 ohms each. New, 10/6 ea. P. & P. 1/-.

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2 only **Transmitter Receivers T.26,** with Mains Power Unit T.744, complete, new. Price: £3/0/0 each. Carriage 7/6.

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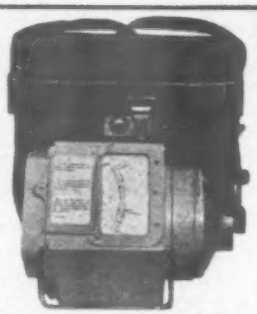
5 only **Power Units T.234A,** complete, used condition. Price: £3/0/0 each. Carriage 10/-.



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7½ amp. D.C. M.I. 3½in. proj. rnd.	12/6
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12 V. D.C. M.C. 2½in. proj. rnd.	8/6
20 V. D.C. M.C. 2in. fl. sq.	9/6
25 Volt D.C. M.C. 2in. fl. rnd.	7/6
30 Volt M.I. 3in. proj. rnd.	10/6
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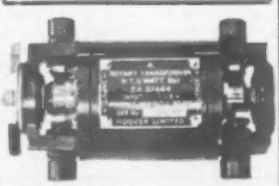
U.S.A. PRECISION SERIES 1345 MULTIRANGE TESTERS for A.C. and D.C. volts, ohms and milliamps., basic movement 400 microamp., in wooden carrying case, complete with test prods, new batteries, guaranteed perfect. Price £6/19/6. P. & P. 2/6.

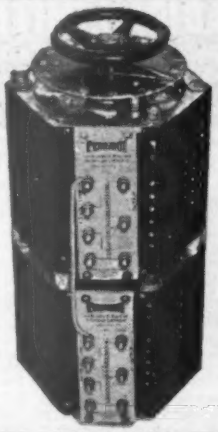


MIDGET ROTARY TRANSFORMERS. 2½in. dia. × 4½in. Input 11.5 volt. Output 310/365 volt at 30 mA. Brand new. 17/6 each. P. & P. 1/6.

DYNAMOTOR (Rotary Converter). 6 volt in, 250 volt out at 100 mA, ex new equipment. 25/- each. P. & P. 2/-.

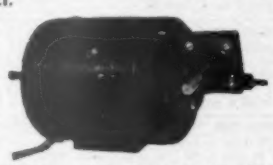
MICROPHONES—NEW. Throat. British, magnetic, 4/6. P. & P. 1/-.
HEADPHONES. 4 000 ohms, imported, new. 15/-.
H.S.30 L.R. U.S.A., min. ear pcs. 19/-. P. & P. on above 1/6 each

SERVICE TRADING COMPANY →

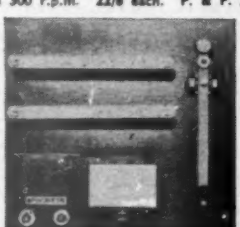


VARIABLE VOLTAGE TRANSFORMER. 230 v. A.C. input. Constantly variable output from 0-270 v. at 18 ampere maximum. Brand new in manufacturers' original cases. £22/10/- each. Carr. paid.

L.T. Transformer. Input 230 v. Output 50 v., 50 ampere, with meter voltage regulator switch on primary. In steel case fitted with mains switch, will take 100% overload. Grs. wt. 150lb. Wound at 800 amps. per sq. in. New, in manufacturers' cases. £15 each. Carr. in Eng. £1.



200/250 v. A.C. Motors. New 1/80 h.p. 2 drives, direct 6000 r.p.m., reduction 300 r.p.m. 22/6 each. P. & P. 2/6.



Morse Practice Set, polished wooden base tapper, adjustable buzzer, battery clips and terminals. Brand new, original manufacturers' packing. 8/6 each. P. & P. 2/-. **Morse Keys.** 8-ampere Service patt. New. 2/6 each. P. & P. 1/-.

Slider Resistance. Heavy duty type, 79 ohms, 2 barrels with gear drive. 2.9 amp.-.65 amp. New. 22/6 each. P. & P. 2/-.

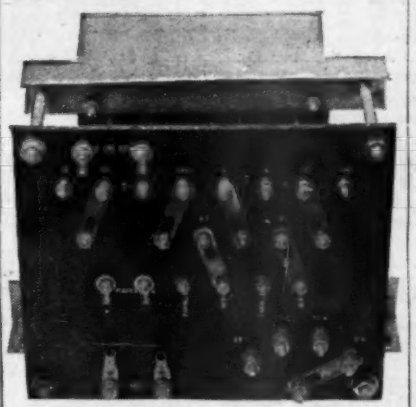
ADMIRALTY VOLTAGE REGULATORS. Input 200/250 v. A.C. output set to 200 v. A.C. Complete with meter in metal case. Current approx. 1½ amp. Price 37/6. P. & P. 3/-.

27-volt 4-pole CHANGE-OVER RELAYS U.S.A. Brand new and boxed. 5/6 each. P. & P. 6d.

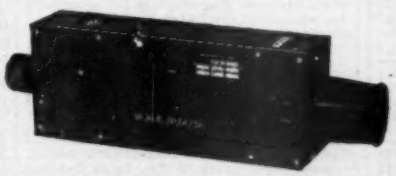
VEEDER REVOLUTION COUNTER, 6 columns, fitted reduction drive, built inside small unit. New 8/6 each P. & P. 2/-.

12 v. D.C. AMPLIFIER, as new, for operation on 12 v. car battery, 12 watts undistorted output, with 6L6 valves in push-pull. Mike/Gram input, tapped output 7½, 15, 62, 100, 250 or 500 ohms. £12/10/0 each. Carr. 15/-.

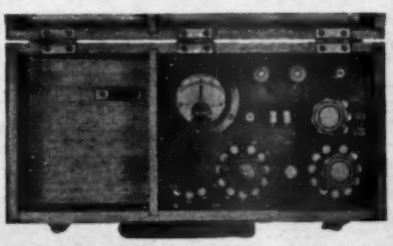
U.S.A. NAVY MODEL "MAN." Crystal controlled radio transmitter and receiver for voice, by frequency modulated signals in the 30-40 megacycle band. Choice of eleven frequencies, powered by 6 volt battery. Complete with valves, crystals, etc., and spares. Unused £25. Carr. Eng. £1.



L.T. TRANSFORMER, real heavy duty job, extremely well made for continuous duty. New in original manufacturers cases. Input 110 v.-260 v. multi-tapped, 50 cycles, single phase. Output 25-29-30-31 v. at 21 amperes. Price 69/6. Carr. 9/-. **AUTO TRANSFORMERS,** step up, step down. 110-200-220-240 v. Fully shrouded, newly manufactured. 300 watt type £2/2/- each. P. & P. 4/6. 500 watt type £3/3/- each. P. & P. 4/6. 1,000 watt type £4/4/- each. P. & P. 4/6. Also 60 watts, 19/6 each. Plus P. & P. 2/-.

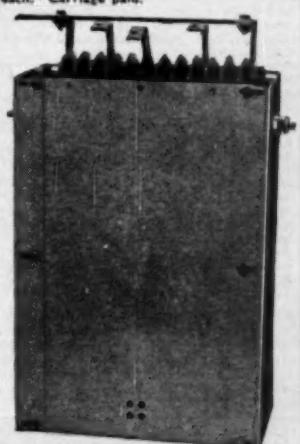


AIRCRAFT CINE CAMERA G45B Mk. III, fully modified, fitted with f/3.5 triple anastigmatic lens, takes 25ft. of 16 mm. film, fitted with 24 v. motor. 16 exposures per sec. Mint condition brand new, in maker's original packing. £6/10/- each. P. & P. paid.



WHEATSTONE BRIDGE UNIT. 4-stud switches 0-10, 0-100 ohms., galvanometer centre zero, F.S.D. 2.5 mA, in oak carrying case 16 × 7½ × 6in., 40/- each. P. & P. 3/6.

U.S.A. FIELD TELEPHONE. E.E.8.B. This world-famous Field Telephone Unit in leather carrying case needs no introduction from us. New. Price £7/15/- each. Carriage paid.



BRAND NEW SELENIUM FULL WAVE BRIDGE TYPE RECTIFIERS, in manufacturers' original packing. D.C. output 36 v. 10 amp., made up of 12 × 110 mm. dia. plates. These fitted in cooling funnel (removable), size 11¼in. × 8in. × 4¼in. Price 45/-. P. & P. 3/3.

PLATE TRANSFORMER. 9,500-0-9,500 volt at 2.9 K.V.A. Oil filled in metal case. Weight 190 lb. Measurements 15 × 15 × 12. Brand new. Perfect. Price £25. Carriage paid.

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COSSOR BEAM OSCILLOSCOPE TYPE 339

Operation 110/200/250 volts A.C. 120 watts. Time Base 10 positions. 6 cps. to 250,000 cps. Amplifier 10 cps. to 2,000,000 cps. Sensitivity, Y1.Y2.3.1 v. D.C. 1.1 v. rms. X. 2.25 v. D.C. .8 v. rms.

Supplied in good working order complete with handbook and circuit. **£27/10/-** each. P/P £1.

AMERICAN MULTI-RANGE TESTMETERS

1,000 ohms per volt, 400 microamp basic movement.

A.C. VOLTS	D.C. VOLTS
2.5 v.	2.5 v.
10 v.	10 v.
50 v.	50 v.
250 v.	250 v.
1,000 v.	1,000 v.
5,000 v.	5,000 v.
D.C. CURRENT	RESIST'CE
1 ma.	500 ohms
10 ma.	100k. ohms
100 ma.	1 megohm
1 amp.	DECIBELS
	−10 to +69

ALL BRAND NEW. COMPLETE WITH INTERNAL BATTERY TEST PRODS AND INSTRUCTIONS. **£5/19/6** EACH. P/P 3/-.

EVERSHED VIGNOLES MEGGER OHMMETERS. 2 ranges, 0–1,000 ohms and 0–200 k. ohms. Ideal for all continuity and polarity tests. Supplied BRAND NEW with all leads, instructions, etc., 59/6 each. P/P 2/-.

AR.88 MODEL "D" SPARES. Brand new 6-bank wavechange switches with screens, 17/6. P/P 2/6. New 1st I.F., 3/6. P/P 9d.

COLLINS 20-WATT MODULATION TRANSFORMERS. Pri. 6,000 ohms, Sec., 6,000 ohms. Push-pull to parallel 807. BRAND NEW, 12/6 each. P/P 1/3.

AMERICAN SUPER LIGHTWEIGHT HEADPHONES. Res. 50 ohms. Fitted with rubber earmoulds, extremely good quality, ideal for comm. receivers, etc. BRAND NEW, 15/-. P/P 1/3.

100 KC/S CRYSTALS. Std. British type, ½in. spacing, 15/- each. P/P 6d.

300FT. COPPER AERIAL WIRE. Ex-U.S.A. 3/6. P/P 1/-.

RCA POTTED OUTPUT TRANSFORMERS 10–15 w. 8,000 ohm CT. primary, sec. tapped. 3. 7.5, 15 ohms. BRAND NEW, 19/6 each. P/P 1/6. **CV967** 1in. C.R.T., 4 v. heater. Suitable for Scope. BRAND NEW, 25/- each. P/P 1/6.

RCA ET 4336 PLATE TRANSFORMERS. Special release, brand new in original transit cases. Primary tapped 200/250 v. 50 cycles. Secondary, 2,000/0/2,000 v. 400 ma., tapped 1,500/0/1,500 v. Price **£12/10/-** each. P/P £1.

55 VOLT 10 AMP. TRANSFORMERS. Input 110/200/250 v. 50 cycles. Sec. tapped at 50 volts. Brand new, 72/6 each. P/P 4/6.

EX-NAVY SOUND - POWERED TELEPHONES. Require no batteries to operate and can be fitted in moments to give complete intercommunication between two points. Hand generator calling. Only 45/- each. P/P 4/6.

MARCONI STANDARD SIGNAL GENERATOR TF-144G. 85 kc/s. to 25 Mc/s. Reconditioned to maker's specification with test certificate, **£65** each. P/P £1.

ROTARY CONVERTORS

12 v. D.C. input. 230 v. A.C. 150 watts 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance, switch, plugs and A.C. mains voltage output check meter. Supplied imperfect condition, individually tested, **£9/19/6** each. P/P 10/-.

HEAVY DUTY MAINS ISOLATION TRANSFORMERS. 230 v. input. 230 v. output, 5 amps. Housed in ventilated metal case. NEW, unused, **£5** each. P/P 10/-.

PORTABLE PRECISION VOLTMETERS BRAND NEW instruments by famous manufacturer. Housed in polished teak case. Moving iron movement reading A.C. or D.C. volts on 2 ranges, 0–160 v. or 0–320 v., 8in. mirror scale. Accuracy within 2%. Supplied at a fraction of original cost, **£5/19/6** each. P/P 3/6.

MARCONI B.29 L.F. COMMUNICATION RECEIVERS. Self contained 7 valve receiver similar to CR.100 covering 15 kc/s to 560 kc/s on 4 bands. Operation 200/250 v. A.C. Supplied in good condition and complete but not tested. Only **£3/19/6** each. P/P 10/-.

CR.100 SPARES KITS

Complete set of new valves 2 X66, 2 U50, 2 DH63, 2 KT63, 6 KTW61. Also set of resistors, condensors, pots, toggle switch and output transformer. Supplied new and boxed, **59/6** each. P/P 4/6.

MARCONI SIGNAL GENERATOR TF-517. Frequency coverage 10–18 Mc/s. 33–58 Mc/s and 150–300 Mc/s. Operation 200/250 v. A.C. Supplied in good working order, **£12/10/-** each. P/P 10/-.

750 WATT AUTO TRANSFORMERS. Ex-Admiralty, fine jobs. Tapped from 110 to 230 v. NEW, **69/6** each. P/P 5/-.

ALKALINE NIFE ACCUMULATORS Banks of 10 cells giving 12 v. 45 A.H. Unused in wooden crates, **£5/10/-** each. P/P 7/6. Size: 26½ x 8½ x 5¼in.

MARCONI TF-373 IMPEDANCE BRIDGES. Ranges 0 to 100H, 0 to 100 mF, 0 to 1 Megohm, 0 to 100Ω. Reconditioned as new to original maker's specification. **£55** each. P/P 10/-.

P/O TELEPHONE HANDSETS. Std. type. BRAND NEW, 12/6 each. P/P 1/3.

CRYSTAL MICROPHONE INSERTS. Only 4/6 each. P/P 6d.

LEACH AERIAL CHANGOVER RELAYS. 12 v. D.C. double pole transmitter type. NEW, boxed, 7/6 each. P/P 9d.

EDDYSTONE MAINS POWER PACKS. Supplied brand new and boxed. 200/250 v. input. Output 175 v. 60 ma. and 12 v. 2.5 amp. Double choke and condenser smoothed. 5Z4 rectifier. Housed in grey metal case. Only 32/6 each. P/P 3/6.

AMERICAN ROTARY TRANSFORMERS. Two models available, either 6 or 12 v. input. Outputs 250 v. 80 ma. D.C., 22/6 each. P/P 3/-. **"C" CORE CHOKES.** All BRAND NEW 5H 200 ma., 16H 120 ma., 20H 80 ma., 100H 30 ma., 10H 250 ma. All 10/6 each. P/P 1/6. 5H 500 ma., 15H 275 ma., 17/6 each. P/P 2/6.

MUIRHEAD PRECISION STUD SWITCHES. 1 pole 24 positions, 4 banks. Self cleaning contacts. NEW, boxed, 17/6 ea. P/P 1/6. Ditto, 2 banks, 10/6. P/P 1/-.

110/230 v. AUTO TRANSFORMERS. ALL NEW boxed. 15/20 w. midget, 9/-; 50 w., 12/6; 100 w., 15/6; 150 w., 21/-. P/P 1/- to 2/-.

R.1155 "N" TYPE SLOW MOTION DRIVES. BRAND NEW, 12/6 each. P/P 1/-.

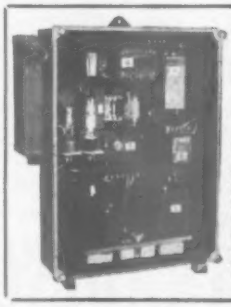
AMERICAN GEARED MOTORS. 24 v. D.C. motor fitted with precision gearbox giving twin outputs of 20 and 6 r.p.m. Also operates on 12 v. ¼in. shafts. BRAND NEW, 19/6 each. P/P 1/6.

W.1191 WAVEMETERS Portable precision battery operated frequency check meters, coverage 100 Kc/s to 20 Mc/s. Supplied complete with all valves and 1 Mc/s Xtal and calibration charts. **£5/19/6** each. P/P 4/-.

WESTON MODEL 772 TESTMETER

A.C. VOLTS	D.C. CURRENT	A.C. CURRENT
2.5 v.	100 micro/a.	500 ma.
10 v.	1 ma.	1 amp.
50 v.	10 ma.	5 amp.
250 v.	50 ma.	RESIST-ANCE
1,000 v.	100 am.	100 ohms
D.C. VOLTS	500 ma.	1,000 ohms
2.5 v.	OUTPUT METER	100k. ohms
10 v.		10 megohm
50 v.		
250 v.		
1,000 v.		

Supplied in perfect working order complete with roxine carrying case, internal batteries and instructions, **£8/19/6** each. P/P 4/-.

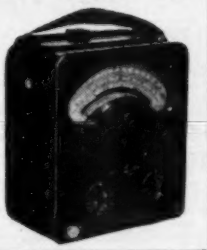


TINSLEY D.C. PHOTOCELL CURRENT AMPLIFIERS.

These special units originally costing in the region of £100 give an amplification of 1 microamp. to 10 ma. Circuit incorporates a 1 microamp mirror galvo. and is supplied with all valves and photocell. Operation 200/250 v. A.C. Size 20 x 15 x 5in. Supplied unused **£6/10/-** each. P/P 10/-.

UNIVERSAL AVOMETER MODEL "D"

D.C. VOLTS	A.C. VOLTS	D.C. Current	A.C. Current
150 mv.	7.5 v.	15 ma.	75 ma.
300 mv.	15 v.	30 ma.	150 ma.
1.5 v.	75 v.	150 ma.	750 ma.
3 v.	150 v.	300 ma.	1.5 amp.
15 v.	300 v.	1.5 amp.	7.5 amp.
30 v.	600 v.	3 amp.	15 amp.
150 v.	750 v.	15 amp.	Resistance
300 v.	1,500 v.	30 amp.	1,000Ω
750 v.			10,000Ω
1,500 v.			



Supplied reconditioned as new, with internal battery, instructions and leads £9/19/6 each. P/P 4/-.

LAVOIE TS-127/U FREQUENCY METERS

The model TS-127/U is a compact, self-contained, battery powered precision frequency meter. Frequency coverage between 375 and 725 megacycles. Each instrument is individually calibrated and charts are supplied with each instrument. Circuit incorporates a 200 microamp tuning meter and unique filament time switch enabling the instrument to be switched on and off unattended. 1.5 v. and 45 v. battery required to operate. Supplied brand new complete with handbook and instructions, £9/19/6 each. P/P 7/6.

NATIONAL H.R.O. MAINS POWER PACKS. The original job made for Senior model receivers. Supplied in good condition, fully tested, 69/6 each. P/P 3/6.

1 OHM 12 AMP. SLIDER RESISTANCES Brand new, 6/6 each. P/P 1/3.

DYNAMO EXPLODERS. For detonating explosive charges. Suitable for quarries, mines etc. Develops 1,800 volts across output terminals. Operation by hand generator. Brand new, 29/6 each. P/P 3/6.

METER BARGAINS

50 Microamp. D.C. M/C., flush sq. 4in.	119/6
50 Microamp. D.C. M/C., proj. rd. 2½in.	49/6
100 Microamp. D.C. M/C., flush rd. 2½in.	42/6
500 Microamp. D.C. M/C., flush rd., 2in.	15/6
500/0/500 Microamp. D.C. M/C., proj. rd. 2½in.	19/6
1 Milliamp. D.C. M/C., flush rd. 2½in.	25/-
30 Milliamp. D.C. M/C., flush rd. 2½in.	9/6
200 Milliamp. D.C. M/C., flush rd. 2½in.	9/6
7.5 Amp. D.C. M/I. proj. rd. 3½in.	10/6
30 Amp. D.C. M/C., flush rd., 2½in.	9/6
15 Volt D.C. M/C., flush rd., 1½in.	10/6
25 Volt D.C. M/C., proj. rd. 2in.	8/6
120 Volt D.C. M/C., flush rd. 3½in.	32/6
300 Volt A.C. M/I., flush rd. 2½in.	25/-
300 Volt A.C. M/C., rectifier, flush rd. 2½in.	25/-
500 Volt A.C. M/I., flush rd., 2½in.	25/-

ALL BRAND NEW AND TESTED

HOOVER MIDGET ROTARY TRANSFORMERS. 12 v. D.C. input. Output 310 v. 30 ma. Brand new, 12/6 each. P/P 1/6.

MIDGET REVERSIBLE MODEL MAKERS' MOTORS. 6 to 24 v. D.C. 8/6 each. P/P 1/-.

A.C. MAINS VOLTAGE REGULATOR TRANSFORMERS. Input 230 volts. Output variable from 185 to 250 volts at max. rating at 24 amps. Ideal for laboratory use, etc., supplied as new, £12/10/- each. P/P 10/-.

6-VOLT VIBRATOR POWER PACKS. Output 120 volts 30 mA. Fully smoothed, uses standard 4-pin Mallory vibrator. New and boxed. 12/6 each. P/P. 2/6.

R.1155 COMMUNICATIONS RECEIVERS MODEL "L"

Incorporates the TRAWLER BAND. Coverage 200-250 kc/s. 600-1,500 kc/s. 1.5-3 mc/s. 3-7.5 mc/s. 7.5-18 mc/s. Supplied in perfect working order, aerial tested, with instruction book, £12/19/6 each. P/P 7/6. Standard MODEL "B" also available fitted with improved N type drive, perfect condition, £7/19/6 each. Combined A.C. mains power supply and output stage suitable for either above, 85/- each. P/P 3/6.

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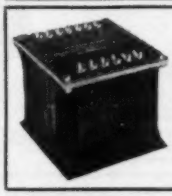


PARMEKOTABLE TOP TRANSFORMERS. Input 230 v. 50 cycles. Output 620/550/375/0/375/550/620 volts 250 ma. Also 2-5 volt 3 amp. windings. Size: 6½ × 6½ × 5½in. Brand new only 45/- each. P/P 5/-.

FERRANTI POTTED FILAMENT TRANSFORMERS. Hermetically sealed, ceramic terminations. All new and boxed, Type 1. 200/250 v. input. Output 6.3 v. C.T. 5.6 a., tapped 5 v. 6.3 v. CT, 4.8 a. tapped 5 v. 6.3 v. CT, 1 a., tapped 4 v., 19/6 each. Type 2. Input 200/250 v. Outputs 6.3 v. CT, 3.3 a. tapped 5 v. 6.3 v. CT, 1 a. tapped 4 v. 6.3 v. CT, .9 a. 6.3 v. CT., 6 a., 15/6 each. P/P 2/-, each type.

BARGAIN GRAM MOTORS. Garrard centre drive motors complete with turntable, 220/250 v. A.C. Adjustable mechanically from 0-45 r.p.m. Only 22/6 each. P/P 3/-.

AVO BATTERY ELIMINATOR POWER PACKS. Operation 200/250 volts A.C. Output 1.4 volts at 300 mA. and 67 volts at 10 mA. Stabilised by VS70, whole unit fully fused. Size 8½ x 5 x 3½in. Ideal for personal battery sets, etc., supplied brand new in maker's cartons. 39/6 each. P/P 2/6.

BATTERY CHARGER or MODEL TRANSFORMERS. All new, boxed. Primaries tapped 200/250 volts. 3.5, 9 or 17 v. 1 A. 9/9; 3.5, 9 or 17 v. 2 A. 14/3; 3.5, 9 or 17 v. 4 A. 16/6; 9 or 17 v. 6 A. 26/-; 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24 or 30 v. 2 A. 21/-. Add postage.

L.T. METAL RECTIFIERS. Full wave bridge connected. 12/18 v. 1. A 6/3; 12/18 v. 2 A. 9/-; 12/18 v. 4 A. 13/9; 12/18 v. 6 A. 18/6; 30 v. 1. A 12/6; 30 v. 4 A. 27/6. Add postage.

PARMEKO MAINS TRANSFORMERS Brand new. Input 230 volts. Output 350/0/350 volts 150 mA. 6.3 v. 4 A. 5 v. 4 A. Only 32/6 each. P/P 2/6.

VARIAC TRANSFORMERS. 230 volt primary. Variable secondary 0 to 250 volts 9 amps. £12/10/- each. P/P 5/-.

24 VOLT 15 AMP. SELENIUM BRIDGE RECTIFIER. Full wave, brand new, 62/6 each. P/P 3/6.

POTTED MAINS TRANSFORMER. Primary 230 volts. Secondary 350/310/0/310/350 volts. 220 mA., 6.3 v. 5 A. 2 x 6.3 v. 3 A. 2 x 6.3 v. 1 A. 5 v. 3 A. Oil filled. 49/6 each. P/P 3/6.

EVERSHED VIGNOLES SERIES II 500 VOLT MEGGERS. 0 to 100 megohm. Complete with leather case. Perfect condition, £15 each. P/P 4/-.

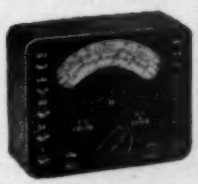
15 WATT AMERICAN TECHRAD AMPLIFIERS. Operation 200/250 v. A.C. Input matched for all types microphone or pickup. Output matched 3, 5, 7.5, 15 or 600 ohms. Uses 4 6J7, 2 6L6 and 5U4g. Superbly made and housed in handsome grey crackled case. Absolutely BRAND NEW, only £13/10/- each. P/P 10/-.

MINE DETECTOR No. 4A.

Complete equipment comprises, search head, amplifier, headset, control box, telescopic rod, search head test unit, depth measure and haversack. Operation from 60 V./1.5 V. dry battery. Brand new in original transit cases. 99/6 each. Plus 10/6 carr.

UNIVERSAL AVOMINOR TESTMETERS

Small, compact, accurate instrument. Resistance measurements from 0 to 20 k. ohms, D.C. volts from 0 to 500 v., A.C. volts from 0 to 500 v., D.C. current from 0 to 500 mA. Supplied in perfect working order, complete with leather case and leads. £5/10/- each. P/P 2/6.



G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

"THE MINOR"

The smallest transistor radio offered on the market. Case size only 3 x 2 x ⅝in. Variable tuning over medium waves. Home, Light and Third programmes without an aerial in areas of reasonable reception. Uses a three-stage reflex circuit of high efficiency. Total cost including Personal phone; transistor; long life miniature battery, circuit and complete layout diagrams and all components:

★ Internal ferrite aerial.
★ Weight less than 2 ozs.

post free **52/6**

All components sold separately. Circuit, layout diagrams and shopping list free.

"THE MAJOR"

STAR FEATURES

★ No aerial or earth.
★ Variable tuning over medium waveband.
★ Internal ferrite aerial.
★ Foreign stations (in areas of reasonable reception).
★ Drilled and mounted chassis.
★ Four stage reflex circuit.
★ Highly efficient.
★ Economical (1½ mA. consumption).
★ May be assembled within an hour.
★ Complete layout diagrams.

Size 4½ x 3 x 1¾in. Total weight less than 4 oz.

We can supply all items including EDISWAN TRANSISTORS in case and personal earphone for **72/6** post free

All parts sold separately.

Circuit, layout diagrams and shopping list free.

AS DESCRIBED IN OCT. ISSUE OF 'RADIO CONSTRUCTOR'

THE "TRANSISTOR–8"
COMBINED CAR-RADIO/PORTABLE
PUSH-PULL SUPERHET

This Portable 8 Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set. Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

STAR FEATURES

★ ALL EDISWAN TRANSISTORS.
★ 250 Milliwatts Output Push-Pull.
★ Medium and Long Waves.
★ Internal Ferrite Rod Aerial.
★ 7 × 4 Elliptical High Efficiency Speaker.
★ Drilled Paxolin Chassis 8½ × 3½in.
★ Transistor Holders.
★ New Point to Point wiring and practical layout.
★ Economical. Powered by 7½ v. battery
★ Highly sensitive.
★ Ideal car radio.

Car Radio Conversion Components 8/- extra. A.V.C. 5/9 extra. 325 MW version 40/- extra.

We can supply these items including Cabinet for £11/10/-. P.P. 2/6. All parts sold separately. Send for FREE circuit diagrams assembly data, illustrations and instructions, and full shopping list.

CALL AND HEAR DEMONSTRATION MODEL

TELETRON "TRANSIDYNE" SIX TRANSISTOR POCKET SUPERHET

STAR FEATURES

★ T.C.C. PRINTED CIRCUIT
★ Internal ferrite aerial.
★ Complete layout diagrams.
★ 6 Transistors (3RF, 3AF).
★ T.C.C. Condensers.
★ Med. and Long waves.
★ Rola 2½in. P.M. Speaker.
★ Powered by two No. 8 batteries.
★ Attractive plastic cabinet.
★ Small size 6½in. x 3½in. x 1¾in.
★ Total weight 20 oz.
★ All the latest components.
★ THE BEST YET!

★ EASY TO BUILD!
★ ALL EDISWAN TRANSISTORS SUPPLIED

THIS SET IS RECOMMENDED AS AN IDEAL POCKET PORTABLE CONTAINING ALL THE LATEST FEATURES GIVING SIMPLICITY IN CONSTRUCTION WITH AMAZING RESULTS.

All components for construction including cabinet, printed circuit, etc., can be supplied for £11/19/6 P.P. 2/6.

All parts sold separately. Send 9d. for circuit, plans and prices.

CALL AND HEAR DEMONSTRATION MODEL

TRANSISTOR RADIO CONSTRUCTOR'S PARCEL

Perdio attractive modern cabinet, 12/6. J.B. screened twin gang 208+176 pf. 10/-. Perdio 2½inch min. 3 ohm speaker, 21/-. Single ended output transformer to match 10/-.

ALL FOR ONLY **49/6** P.P. 2/6.

TRANSISTORS AND TRANSISTOR COMPONENTS A SPECIALITY. A LARGE RANGE OF THESE COMPONENTS ARE ALWAYS IMMEDIATELY AVAILABLE. SEND FOR COMPLETELY NEW FREE LISTS AND CIRCUITS.

TRANSISTOR SQUARE WAVE GENERATOR. Complete Kit with 2 Transistors, Components, Circuit and plastic case. Post free **20/-**

TRANSISTOR SIGNAL TRACER. Complete Kit with 2 Transistors Components, Phones and Circuit and plastic case etc. Post free **37/6**

NEW TRANSISTORS:— PRICE REDUCTIONS

(Junction Type PNP)

Ediswan XA104 6 Mc/s osc/mixer, RF	18/- ea.
Ediswan XA103 4 Mc/s RF and IF amp.	15/- ea.
Ediswan XB104 Audio Output etc....	10/- ea.
Matched pair XB104 for up to 250 mW audio output	20/- pr.
New market power transistors:	
V15/10P: 15 volt 10 watts	20/- ea.
V15/20P: 15 volt 10 watts	39/- ea.
V15/30P: 15 volt 10 watts	48/- ea.
V30/10P: 30 volt 10 watts	48/- ea.
V30/20P: 30 volt 10 watts	54/- ea.
V30/30P: 30 volt 10 watts	57/- ea.
V15/20IP: 15 volt 2 watts	25/- ea.
V30/20IP: 30 volt 2 watts	35/9 ea.
Red spot 800 kc/s Audio amp.	7/6 ea.
White spot 2 to 5 Mc/s RF etc.	12/6 ea.
Green/Yellow Audio Amplifier	7/6 ea.
Red/Yellow 1.5 to 8 Mc/s RF or IF etc.	15/- ea.

Complete data sheet available on all types. FULL TRADE DISCOUNTS ON ALL TYPES

HENRY'S RADIO LTD.
(Dept. W/WJ)

5, HARROW ROAD, PADDINGTON, W.2
(Opposite Edgware Road Tube Station) PAD 1008/9

PIRANI HIGH VACUUM TEST EQUIPMENT
COMPLETE set of Instruments including calibrator and PYE Scalelamp galvo.
£33/10/- Post free.
BRAND NEW. BOOKLET ON REQUEST

FERRANTI TEST VAC.
High-Speed Vacuum Tester with Charts. 200/250 volt 50 c/s supply.
BRAND NEW **£10/10/-** Post free.

WAVE-GUIDE WATTMETER
Type W892I 10 cm. Complete in transit case
BRAND NEW **£5/10/-** P.P. 7/6.

EVERSHED VIGNOLES WEE MEGGER
500 volt 50 Meg. BRAND NEW sealed in carton with leather case and handbook.
£12/10/-
100-volt type used but in new condition With Leather Case **£6/-/-** Post free.

RADAR UNIT TYPE T28/APT-1 (1683)
Complete with the following valves:
2—6C4; 832A; 829B; 2—5R4G; 3—6AC7; 6V6GT; 931A photo multiplier with associated network. Also 2-blower motors. Input 30-115 volt 400 to 2 600 c/s. cd 26 v. d.c. BRAND NEW and boxed. **£6/10/-** Post free.

CRYSTAL CALIBRATOR
For No. 19 Set.
10 Kc/s.; 100 Kc/s.; 1 Mc/s.; spot frequencies; Crystal controlled oscillators; includes 5—12SC7 valves, neon modulator handbook, etc.
BRAND NEW **£4/19/6** Post free

MIXER UNIT TYPE 79
Frequency range 172 to 190 Mc/s. Comprising: VCR139A Cath. ray tube; 7—EF50; EF55; 4—EA50; 2—EB91; 5U4; VU120, and EC52 Standard main input 200-250 volts 50 c/s. Ideal Scope Basis
£5/10/- Carriage 5/-.

WALKIE/TALKIE TYPE 38 TRANSMITTER/RECEIVER
Complete with 5 valves. In new condition. These Sets are sold without Guarantee, but are serviceable. **22/6** P.P. 2/6.
H/phones 7/6 pair, Junction Box 2/6. Throat Mike, 4/6. Canvas Bag, 4/-. Aerial Rod, 2/6.

TRANSMITTER/RECEIVER
Army Type 17 Mk. II
Complete with Valves, High Resistance Headphones, Handmike and Instruction Book and circuit. Frequency Range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles.
Power requirements: Standard 120 v H T and 2 v. L.T.
Ideal for Civil Defence and communications. BRAND NEW **45/-**
44-61 Mc/s. Calibrated Wavemeter for same. 10/- extra.

RF WATTMETER TS/87/AP.
3 switched positions 0/10/15/30 watts. Complete with photo-cell spare lamps; calibration charts; leads and transit case.
BRAND NEW **£8/19/6** P.P. 7/6.

SYNCHRONIZER UNIT
Includes: 3—6L6M; 12—6AC7; 6SQ7; 5—717A; 6—6SN7GT; 6H6; slow motion drive, blower motor, transformers etc. **£4/19/6** P.P. 5/-.

PACKARD BELL PRE-AMP.
Complete with screened case with 6SL7GT; 2BD7; leads, jack plugs; handbook etc. Sealed in carton. Only **12/6** P.P. 2/-.

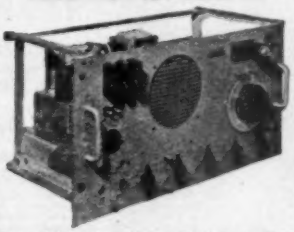
RIBBON MICROPHONES. Brand new desk type, with lead. Only **65/-** P.P. 2/6.

MORSE PRACTICE BUZZER UNITS
On board with key and buzzer only 4/6 each. Headphones 7/6. Requires 4½ volts only.

BC929A INDICATOR
Includes: 3BP1 tube; 2—6H6GT; 2—6SN7GT, 6G6G; 6X5GT; 2X2G; large 24 volt motor drive switch etc. **65/-** P.P. 5/-.

182A INDICATOR
Includes: 517C tube, 4—SP61; 5U4G; transformers etc. **57/6** P.P. 5/-.

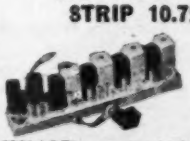
Sputnik Special
SHORT-WAVE COMMUNICATION RECEIVER
10-60 Mc/s. (5-30 Metres)
RECEPTION SET TYPE 208



Containing 6 valves: 2-6K8G, 2-EF39, 7Q6G and 6V6G, Metal rectifiers, built-in mains pack and 6 v. Vibrator pack, built-in 6½in. speaker. Muirhead slow motion drive. B.F.O and R.F. stage. 2 Mc/s. I.F. freq. Provision for 'phones and muting and 600 ohm line. Input 100/250 v. A.C. Vibrator pack included for battery operation (6 volt).
£6/19/6 Carr. 15/6.
Complete in case.
In new condition and air tested.

PYE 45 Mc/s. STRIP TYPE 3583.
Complete with 12 valves. 10—EF50; EB34; EA50, with modification data.
ABSOLUTE BARGAIN **39/6** Carriage 5/6.

"373" MINIATURE IF STRIP 10.72 Mc/s



The ideal F.M. conversion unit as described in "P.W." April/May, 1957. Complete with 6 valves, three EF91's, two EF92's and one EB91. I.F.T's etc., in absolutely new condition. With circuit and conversion data
12/6 (less valves) NOW **37/6** (with valves)
Postage and packing 2/6 (either type)
FM AT ITS CHEAPEST!

RF UNITS TYPE 25 Switched
Tuning 30 to 40 Mc/s. Includes 3 SP61's. Carriage 2/6. **10/-**
TYPE 26: Variable tuning 50 to 65 Mc/s. including 2 EF54's and 1 EC52. Carriage 2/6. **25/-**
(Circuits in stock for both types 9d.)

SCR522 TRANSMITTER RECEIVER
All complete in new condition less valves.
35/- P.P. 5/-.

STROBE UNIT
Complete with: 6—EF50; 5—EA50; SP61. Relays etc. **35/-** P.P. 2/6.

APQ9 HF UNIT
Includes 931A photo-multiplier, 2-807, 3-6AC7, 2-8012 HF. Gear drives. Blower motor. Mains transformer, etc. **£7/10/0** P.P. 7/6.

AC/DC PORTABLE RADIO
A well-known manufacturer's product.
★ 5-valve superhet;
★ Built-in frame aerial;
★ Marconi valves throughout;
★ Three wavebands: Med. long and short, or Med. and 2 short wavebands.
★ 7 × 4 Elliptical speaker;
★ Slow motion tuning;
★ Size 10 × 9½ × 4in.;
★ Provision for gramophone pick-up;
COMPLETE **£7/12/6** P.P. 7/6.
Polished Cabinet 27/6; Super Rexine Cabinet 37/6. Fully guaranteed.

A.C./D.C. 200/250 v.
Portable-Gram AMPLIFIER
Completely assembled on baffle board size 12½in. x 4½in., depth 3in. Containing two Mullard valves type UL84 and UY85, Elac 7in. x 4in. elliptical speaker, volume control, tone control. Nothing else to buy, just plug in to mains and connect your pick-up to amplifier. **67/6** Carr. 2/6.
Absolute bargain

NEW BOXED VALVES!
EQUIVALENT TO FOLLOWING TYPES

AC/SG	MKT4	SP4(7)
AC/SGVM	MS4B	TDD4
AC/PEN	MVS/PEN(7)	URIC
AC/VP1(7)	MVS/PENB	VMS4
AC/VP1(5)	MVS/PEN(5)	VP4(7)
AC/VP2	MS/PEN(5)	VP4B
AC/HLDD	MS/PEN(7)	VP4(5)
CY1C	MX40	VMP4G
DDT4	PEN4VA	W42
FC4	PEN36C	ID5
GU50	PP36	7D5
H30	SP4(5)	7D6
MHD4	S4VB	41MPG
		AZ31

PM24D 12/6 each
PX25 12/6 each
10/- Each
SEND FOR FREE COMPLETE VALVE LIST OF OVER 400 DIFFERENT TYPES!

CRYSTAL MIC. INSERTS

½-inch Square	3/6
Acos ½-inch Round	5/-
Acos 1¼-inch Round	7/6
Acos 2-inch Round	12/6
Lightweight moulded hand microphone case, suitable for any of the above inserts ONLY	2/6

VIBRATOR PACKS. Input 6 v. D.C. Output approx. 100 v D.C. at 3 m/amps., fully smoothed and R.F filtered. Size 6½ × 5 × 3in. Fitted with Mallory 629C vibrator, BRAND NEW, Boxed **12/6**

QUARTZ CRYSTALS
A large range of frequencies in stock from 100 Kc/s. upwards Fundamentals; 5th and 2nd harmonics. Send for free comolete list

U.S.A. TESTMETER TYPE "834-S" AC/DC 15—RANGES F.S.D. 1,000 O.P.V AC/DC
Volts 12/60/300/600 v./1,200/6,000 v.
Milliamps. 1.2/12/60/600 mA. **£6/19/6**
Ohms 0-5,000/5 meg.
Complete in wooden carrying case with leads and internal batteries.
A "must" for the designer, experimenter and service man.

DYNAMOTORS
12 volts d.c. input, 230 volts 165 mA. output,
32/6 Post free.

RCA 6½-inch P.M. SPEAKER in Cabinet.
With vol. control and 600 v. Line Trans
27/6 P.P. 2/6.

INDICATOR UNIT TYPE 247
R.F. POWER WATTMETER. Complete with 4½in. 1 mA. Meter, Magic Eye indicator; 2 EP50 diodes and rectifiers. Inputs:—12 v.; 80 v. D.C. or 100/240 v. A.C., 50 c/s. NOW ONLY **£3/19/6**

10 INCH P.M. SPEAKER
In portable baffle cabinet with 30ft. twin cable and jack plug. Brand new and sealed.
45/- P.P. 5/-.

TV PRE-AMP. 45 Mc/s Unit with 2-VR91 valves (Slight modification necessary.) 10/- post free.

HENRY'S RADIO LTD.
(DEPT. WWJ)

5, HARROW ROAD, PADDINGTON, W.2
(Opposite Edgware Road Tube Station) PAD 1008/9

Fluorescent Lighting

Complete lighting fittings. Built-in ballast and starters—stove enamelled white and ready to work. Ideal kitchen, workshop—anywhere. Twin 20 approximately 27in. long complete with two 20W tubes **39/6**. Single 40 approximately 4ft. long complete with one 40W. tube, **39/6**. Inductor 80 approximately 5ft. long complete with one 80W. tube, **59/6**. Carriage and insurance up to 150 miles 5/6, up to 250 miles 7/6.

Don't Be Caught Like This

Car Starter Charger Kit

All parts to build 6- and 12-volt charger which can be connected to a "flat" battery and will enable the car to be started instantly. Kit comprising the following.

Mains transformer	22/6
5-amp. rectifier	17/6
Regulator Stud Switch	3/6
Resistance Wire	2/-
Resistance Former	2/6
Mains on/off Switch	2/6
0-5 amp. Moving Coil Meter	12/6
Construction Data	1/6

or if bought all together price in.. **83/6** plus 3/6 post and packing.

Hi-Fi Snip Infinite Wall Baffle

Nicely veneered and polished. Corner fitting (attaches to picture rail). Takes up no floor space. Gives really fantastic results with only low-priced 8in. speaker. Fitting for tweeter. Only **45/-** each, carriage and insurance 2/6.

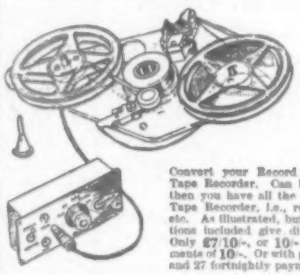
Selenium rectifier type 809 v. ½ amp. half wave easily rebuilt into full wave or multiple type, contains thirty 36 mm. discs. Price **8/6**, plus 1/6 post.

Type 36 v. 9 amp., easily rebuilt into six full wave charger rectifiers suitable for charging 6 or 12 v. batteries at 3 amps., contains twenty-four 84 mm. discs. Real bargain at **10/6**, plus 1/6 post.

Pullin Series 100 Test Set

Undoubtedly a most useful instrument by a firm long famous for fine instruments. Entirely redesigned, it has a square movement with Cascon plastic cover; this makes for a brighter, more readable scale, extra scale length and wider angle of vision. With the test set is included a pair of combined test prods and crocodile clips also a stand for inclining the meter at the best reading position. Ranges: a.c. volts: 0-10, 0-25, 0-100, 0-250, 0-500, 0-1,000: ditto d.c. A.C. current: 0-100 mA.; d.c. current: 0-2.5, 0-10, 0-100, 0-500 mA. Resistance: 0-1M and 0-10kΩ.

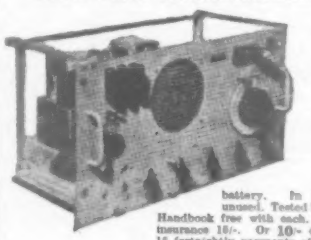
Price **£12/7/6**, plus 5/- carriage and insurance or **£1** deposit and 24 fortnightly payments of **10/-**. **FREE GIFT.** All purchasers this month will receive a series 100 range extender scale and data which adds capacity 2 pfd.-1 mfd. in two ranges, inductance, E.H.T. and many others.



Gram into Tape Recorder

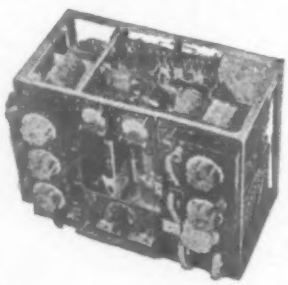
Convert your Record Player or Radiogram into a Tape Recorder. Can be fitted in a few seconds and then you have all the facilities afforded by a normal Tape Recorder, i.e., record, playback, erase, rewind etc. As illustrated, but less pre-amp. (Note: instructions included give diagrams of suitable pre-amp.). Only **£7/10/-**, or **10/-** down and 16 fortnightly payments of **10/-**. Or with pre-amp. **£13/2/6**, or **£1** down and 27 fortnightly payments of **10/-**.

Short Wave Communications Receiver R208



This is a super short wave receiver covering 5-30 metres (10-60 Mc/s). Uses 6 valves. Has R.F. stage, 2 I.F. stages B.F.O., etc. Muirhead instrument drive, two internal power packs, mains and battery vibrator pack. Complete with own P.M. speaker. Provision for phones and speaker muting. Complete in metal transit case; size approx. 24 × 18 × 12in.; weight 70lb. Suitable A.C. mains, 100-250 and 6 volt battery. In perfect condition, practically unused. Tested before despatch and guaranteed. Handbook free with each. Price **£6/19/6**, carriage and insurance 15/-. Or **10/-** deposit plus 10/- carriage, and 15 fortnightly payments of **10/-**.

Famous Transmitter Virtually Given Away



The famous R1154—unused but slightly soiled and not tested. Covers 200-500 kc/s, 2-8.5 Mc/s, and 5.5-10 Mc/s. Has unique "click stop" mechanism (7 stops) and permits selected frequency to be held, returned to, etc. Hartley oscillator, power amplifier, keying and speech. Wonderful breakdown valve meters, relays, switches. Complete with valves—real bargain at **29/6**, plus 10/- carriage.

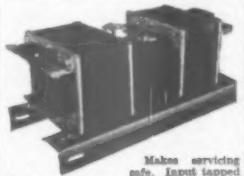
A.C./D.C. Multimeter Kit

Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions, price **19/6**, plus 2/6 post and insurance.

Instantus Heater

Convector heater. Made from heavy gauge sheet steel (galvanised). For greenhouse, workshop, aviary, etc., 500 watt, **£1/12/6**; 1,000 watt, **£2/10/-**; 1,000 watt with wired but separate thermostat. **£3/17/6**. 2K watt free standing or wall mounting. **£3/19/6**; 2K watt with built-in thermostat. **£4/19/6**. Carriage and insurance 5/- per heater. ALL ARE GUARANTEED FOR 5 YEARS.

Mains Isolation Transformer



Makes servicing safe. Input tapped 200-250 v., output tapped 200-250 v. Rated at 500 watts, intermittent rating 2,000 watts. Screens for suppressing mains interference. Size 14in. × 6in. × 9in., weight 40 lb. Price **£5/12/6**. Carriage 7/6 (up to 250 miles).

Speaker Bargain

12in. Hi-Fidelity loudspeaker. High flux. Permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price **32/6**, plus 2/6 post and insurance.

14in. T.V. Cabinet

14in. T.V. cabinet of the latest styling—beautifully veneered and polished—limited quantity, sale price **15/-** each. Carriage and packing 3/6 extra. Masks 10/- extra.

Beginner's Superhet

All the components including metal chassis, valves, metal rectifier, coils, tuning condenser, etc., required to build the "Beginner's Superhet" as described in the January issue of "Practical Wireless" are available as a parcel. Price **£3**, plus 3/- post and ins.

ELECTRONIC PRECISION EQUIPMENT LTD.

66, Grove Road, Eastbourne, Sussex.

This is the correct address for post orders, and for prompt attention please mark your envelope Dept. 2. Also add enough for postage.

For convenience of callers, all items advertised may be obtained at the following companies.

ELECTRONICS (Ruislip) LTD.
42-46, Windmill Hill, Ruislip, Middx.
Phone: RUislip 5780
Half-day Wednesday

ELECTRONICS (Croydon) LTD.
266, London Road, Croydon.
Phone: CRO. 6558
Half-day Wednesday

ELECTRONICS (Finsbury Park) LTD.
29, Stroud Green Road, Finsbury Park, N.4.
Phone ARChway 1049
Half-day Thursday

See and Hear all the latest STEREO & Hi-Fi

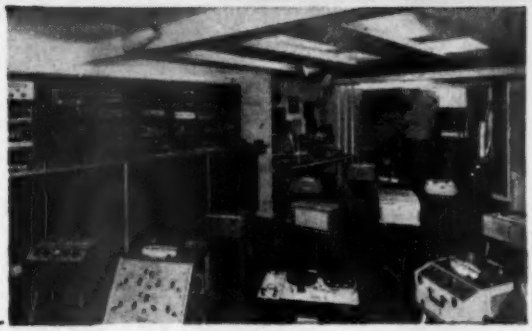
LASKY'S RADIO

IN LONDON'S NEWEST AND BEST

Demonstration Studio NOW OPEN

42 TOTTENHAM COURT ROAD, W.1

Photo shows only a section of our fine new Studio. Come and have comparative demonstrations under ideal conditions, our specialist staff will give you technical gen and all the assistance and service you require.



AMPLIFIERS. QUAD, ROGERS, LEAK, RCA, JASON, LINEAR, PAMPHONIC, DULCI, W/B, AVANTIC, ARMSTRONG. Etc.

SPEAKERS. WHARFEDALE, GOODMANS, LOWTHER, G.E.C., LORENZ PHILIPS, TANNOY, Etc.

PICKUPS. COLLARO, GARRARD, CONNOISSEUR, LEAK, B/J, ORTOFON, GOLDRING, Etc.

TRANSCRIPTION TURNTABLES. COLLARO, GARRARD, LENCO, CONNOISSEUR.

TAPE RECORDERS. GRUNDIG, ELIZABETHAN, BRENELL, TRUVOX, SOUND, VORTEXION, FERROGRAPH, HARTING, ELON, REFLECTOGRAPH, SIMON, STUZZI, TANDBERG, TELEFUNKEN STELLA, WALTER.

CABINETS. Wide selection including the NEW G-PLAN and NORDYK CONTEMPORARY CABINETS.

DULCI "STEREO EIGHT" PRE-AMPLIFIER

For high quality **MONAURAL** and **STEREO** reproduction. 8 valves, printed circuit construction. Suitable for all types of pickups, tuners, tape (direct from heads), recorders (special facilities for stereo conversion) and microphones. **22 Gns.**

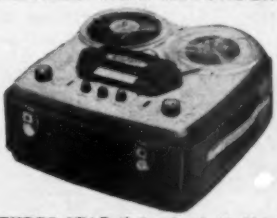
DULCI "STEREO TWO" PRE-AMPLIFIER. Stereo/Monaural, for use with crystal pickups, tuners and compensated tape. 2 twin triodes, printed circuit construction. **9 Gns.**

DULCI TWIN (STEREO) POWER AMPLIFIER. Mdl. SP44. 8 watts (4 watts per channel), **12 Gns.**

HIRE PURCHASE

No restrictions! DEPOSIT AND MONTHLY PAYMENTS TO SUIT YOU. Call or write stating your requirements.

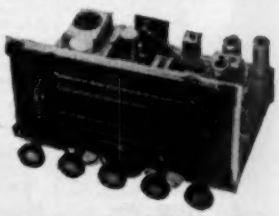
BRENELL TAPE RECORDERS



"THREE STAR." 3-spd., 1⅞, 3¾, 7½ i.p.s. Push-button control, digital rev. counter. Printed circuit Amplifier of 4 watts output. Price with 1,200 ft. tape, empty spool and microphone, **58 Gns.**

BRENELL "MARK 5." 4-spd., 1⅞ 3¾, 7½, 15 i.p.s. Uses spools up to 8½in. dia. Price, including 1,200 ft. tape, **64 Gns.** Brenell Decks, Amplifiers and Pre-Amplifiers available separately. Data and prices on request.

LASKY'S LATEST SCOOP



COMBINED AM/FM TUNER, CONTROL UNIT AND AUDIO PRE-AMPLIFIER

(self-powered)

Mdl. H11 by famous manufacturer. Note these star features:

- ★ FM plus Long, Medium and Short reception
- ★ High Fidelity Audio Pre-Amplifier
- ★ Independent Bass and Treble Controls
- ★ Pick-up Matching Device and Switch positions for LP and 78.
- ★ Tape Record and Replay facilities
- ★ For use with any Hi-Fi Amplifier
- ★ Magic Eye Tuning Indicator.

For A.C. 200-250 v. 7 B.V.A. glass miniature valves, ECC85, ECH81, EBF89, two EF86, EM81, EZ81, and two matched Diodes. Glass dial, 11¼in. x 5¼in., fine readings and 'LOG' scale. Dimensions: length 12in., depth 9in. from dial front, 10in. including knobs and spindles, height 7¼in. LISTED AT £29/3/10.

LASKY'S PRICE 20 Gns.

Carr. and Pkg. 12/6.

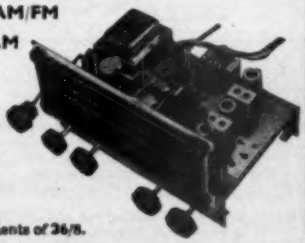
Available on H.P. terms to suit you. Full details of this superb hi-fi equipment post free.

STEREOPHONIC P.U. CARTRIDGES

The new **RONETTE** turnover **83/5**
B.J. with diamond... **7 Gns.**
also
with plug-in head... **8 Gns.**
ACOS turnover..... **55/5**
B.S.R. turnover..... **69/6**
All available types in stock.

JASON STEREO KITS in stock

6-VALVE AM/FM RADIOGRAM CHASSIS



By famous manufacturer. Magic eye indicator, 6 valves. Incorporates the Gorier F.M. tuning unit. Brand new, perfect and fully guaranteed. Size: 12 × 7½ × 7¼in. high. Limited number.

LISTED AT 22 GNS. *LASKY'S PRICE* **£17.19.6**

Carr. and Packing 12/6

Easy Terms: £3/12/- deposit and 12 monthly payments of 26/8.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

LASKY'S RADIO

LOOK! A 4-SPD. MIXER AUTO-CHANGER FOR ONLY 79/6

Carr. & Pkg. 5/-.

The well-known STAAR GALAXY, LISTS AT £12

For Mains 200/250 v. A.C. Of modern design and smart duo-tone finish, complete with crystal pick-up with styli. Incorporates auto and manual control, with finger-tip stop, start and speed change. Instruction and Service booklet supplied. Offered by Lasky's Radio at ONE-THIRD LIST PRICE! Limited quantity, so buy now!

Motor Board, plywood, cut out to fit size 15½in. × 12½in., available if required, 3/6 extra.

FULL RANGE OF SPARE PARTS IN STOCK. Instruction and Service booklet including detailed list of all parts, 1/9 post free.

NOTE THESE VALUES IN 4-SPEED MIXER AUTO-CHANGERS

B.S.R. 4-spd. mixer Auto-Changer type UA8, manual and auto-control, complete with latest B.S.R. "ful-ß." pick-up. Carr. & Pkg. 5/- **£6.19.6**

Collaro RC.456. Incorporating auto and manual control. Complete with Studio crystal p.u. and sapphire stylus. List £13/17/-. **LASKY'S PRICE £7.19.6** Post 3/6.

Garrard 120, MK. II, **£9/19/6.**
Garrard 121, MK. II, **£10/19/6.**

COLLARO 4-SPEED SINGLE RECORD PLAYER

Model 4/554 complete with Studio T or O p.u.

£6.19.6 Post free.

Garrard 4SPH Single Player **£7/19/6.** Post free.

Collaro "Junior" 4-spd. motor and p.u. with HGP50 cartridge. Post 2/6. **89/6**
Motor only **59/6,** post 2/6.
Pick-up only **29/6,** post 2/6.
GARRARD Auto-Changers, Transcription Motors, Pick-Ups, all latest models in stock.

CARRYING CASES

Large range of attractive, well made cases for single record players, auto-changers and tape decks, at bargain prices. Call and select your requirements or send for list.

MULLARD 3-3 AMPLIFIER

Built to Mullard's exact specification, with 3 Mullard valves EL84, EF86, EZ81, complete with front panel. Post free. **8 Gns.**

LASKY'S 4 WATT PORTABLE GRAM AMPLIFIER

Will suit any type of crystal or magnetic pick-up. Uses 3 valves: EL84 output L63 and EZ80 rect. Speaker and controls are separate and can be mounted anywhere in cabinet where most suitable. COMPLETE with 3 valves and knobs less Speaker. **79/6**
Carr. 5/-.
7in. × 4in. Plessey Elliptical Speaker, if required, **19/6** extra. Details, circuit diagram post free.

LASKY'S PORTABLE GRAM AMPLIFIER KIT

2 watts. Note small dimensions, approx. 6½in. × 3½in. max. height 5in. Uses EL84 output and 6X4 rectifier.

COMPLETE KIT, including valves, printed circuit, full instructions, less Speaker. **49/6**
Carr. 2/6.
7in. × 4in. "Elac" Elliptical Speaker, if required, **14/6** extra.

DUAL CONCENTRIC SPEAKERS (15in.)

Famous make. High Fidelity, 25 watts, 15 ohms imp., full freq. range 20 c.p.s. to 17,000 c.p.s., resonance 20 c.p.s. Complete with crossover unit. List £27/4/6.
LASKY'S PRICE £16.19.6
Carr. 7/6 plus 30/- for wood packing case (returnable).

RICHARD ALLAN 10x2½in. RECTANGULAR

P.M. Speaker (closed field magnet), 3 ohms speech coil. Ideal for use with tape recorder, TV or any equipment requiring large output from a small size speaker. **27/6**
Post 1/3.

SPECIAL PURCHASE
PLESSEY P.M. Speakers. 5in. round or 7 × 4 elliptical. Brand new. **LASKY'S PRICE 14/6**
Post 1/6

MULLARD 510 AMPLIFIER KIT

All specified components and your choice of transformers and chokes by Partridge, Haddon, W/B, Ellison or Gilson.

COMPLETE KIT of parts and printed circuit as low as **9 gns.** Details on request. Book 3/6 post free. Printed Circuit separately £2/2/6. Also available built ready for use. Price according to transformers used

ALL "LINEAR" AMPLIFIERS STOCKED

'LINEAR' STEREOPHONIC GRAM AMPLIFIER. Gives realistic output when connected to 200–250 v. A.C. mains, stereo pick-up head and good speakers. Incorporates outputs for two matched 2–3 ohm speakers. Can also be used as a straight 6-watt amplifier. Instructions supplied.
Post & Pkg. 5/-. **£6.19.6**

"LINEAR" TAPE DECK AMPLIFIER. Type LT45. A complete unit (power pack and oscillator incorporated) ready for connection to 200–250 v. A.C. mains. 3-ohm loudspeaker and practically any make of deck. Suitable for Collaro Tape Transcriptors (all Marks), Brenell, etc.
Complete
Post & Pkg. 5/- **12 gns.**

"LINEAR" 'CONCHORD.' A high fidelity 30-watt Amplifier incorporating Pre-Amplifier and tone controls. Employs the latest Mullard EL84 output valves in ultra linear operation and high grade sectionalized output transformer. **15 gns.**
Post & Pkg. 7/6.

"LINEAR" 'DIATONIC.' High fidelity 10-14-watt ultra linear Amplifier with integral Pre-Amp and tone controls. Two individually controlled inputs provide mixing facilities for microphone and gram. etc., etc., **12 gns.**
Post & Pkg. 5/-

Literature giving full details of the above "Linear" products post free on request.

MICROPHONE BARGAINS

ACOS type 33/1, Crystal hand or table Microphone.

Incorporates specially designed acoustic filter. Flat response 30–7,000 c.p.s. Omni/directional. Suitable for tape recording, public address, etc. Attractive dark brown plastic case. Brand new in maker's cartons. List 50/-.
LASKY'S PRICE 29/6
Post 1/6.

ACOS CRYSTAL PENCIL MIKE, type MIC.39/1, complete with cable. Listed at £5/5/-.
LASKY'S PRICE 59/6
Post 1/6.
In presentation case with Desk Stand, **69/6.** Post 2/6.

ACOS Sub-min. Crystal Microphone Inserts type MIC.17. Size approx. ⅜in. square, 7/32in. thick. Brand new and boxed. Each **3/6**
Post 1/-.

MOVING COIL P.M. SPEAKERS

2½in. **17/6.** 3in. and 3½in. **19/6**
5in. **14/6.** 6½in. **17/6.** 8in.... **19/6**
10in. **29/6.** 12in. **29/6**
6½in. with transformer **21/-**
7 × 4in. Elliptical **19/6**
10 × 7in. Elliptical **32/6**

SPECIAL TAPE OFFER

Famous make, P.V.C. base on latest type plastic spools. Brand new, perfect, boxed and guaranteed.

1,200ft. on 7in. Spool... **21/-**
850ft. on 5½in. Spool **16/6**
600ft. on 5in. Spool... **12/6**
400ft. on 4in. Spool... **7/11**
250ft. on 3in. Spool... **6/6**
Post: 1 Spool, 1/6.
Orders over 60/- post free.

TAPE DECKS

SPECIAL OFFER OF COLLARO TAPE TRANSCRIPTOR, Mk. III, fitted with digital counter. Limited quantity only. List £22. **Lasky's Price £17/19/6.** Post free.

COLLARO TAPE PRE-AMPLIFIER, fitted and wired. **£21.**
COLLARO TAPE TRANSCRIPTOR Mk. IV. **22 gns.**
LANE DECK **£18/10/-.**
WEARITE DECKS **£35, £40** and **£45.** Carr. extra.

SPECIAL OFFER!

COLLARO 4-spd. Transcription Turntables, 4T200/PX, with Studio trans. p.u. Brand new and unused List £19/10/-.
Lasky's Price £16.19.6
Carr. & Pkg. 7/6
Without p.u. **£13/19/6.**

PICK-UP CARTRIDGES

GARRARD MAGNETIC t/o. p.u. Cartridges. Type TOM/2, less than half price. **25/-**

ACOS turnover, complete with L.P. and standard styli. List £2/1/7. **LASKY'S PRICE,** Post 1/-. **18/-**

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

Lasky's "Easy-to-Build" Radios

TRANSISTOR PORTABLE

For Construction on Printed Circuit 6¼in. × 2¼in. using 7 Transistors and 1 germanium diode; 6 v. operation; very low consumption, 200 milliwatts p.p. output; Ferrite rod aerial; fully tunable; choice of 7in. × 4in. elliptical or 3½in. P.M. speaker; choice of cabinet. Circuit diagram and full building instructions supplied.

CAN BE BUILT FOR **£9.19.6** Post & Pkg. 3/6

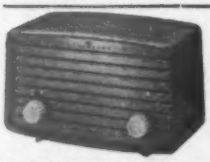
Full data and building instructions available separately, 1/6 post free.

4 VALVE SUPERHET PORTABLE

The performance of this 4-valve medium and long wave superhet Portable equals that of ready-built sets costing pounds more.

FOR ONLY £7/7/- plus 5/6 carr. and pkg. you can build this battery Portable using all brand new components and valves. Printed circuit, circuit diagram and full instructions supplied. Only batteries extra.
Circuit diagram and full data 1/6.

FOR ONLY £9/9/- plus 5/6 carr. and pkg. you can build this job as a mains and battery Portable using our specially designed build-it-yourself Power Unit for 200-250 v. A.C.



NEW MIDGET T.R.F.

Handsome contemporary design case, overall size 8¼in. wide, 4¼in. deep 5in. high. 2 latest double-purpose valves EBF89 and ECL80, contact cooled rectifier. For A.C. mains 200-250 v. med. and long wave 5in. P.M. speaker. Plastic cabinet in cream, pastel green, pink, blue.

CAN BE BUILT FOR **£4.19.6** Post & Pkg. 5/-.

FULL DATA, instructions, circuit diagram, shopping list, 1/6.

CABINET only as illustrated. 14/- plus 4/6 post and pkg.

LASKY'S TRANSISTOR SUPERHET TUNER

For construction on a Printed Circuit

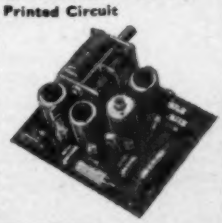
Uses three R.F. Transistors and one Germanium Diode three I.F. transformer. Ferrite rod aerial. Operates on one 6 v. battery and one 1.5 v. cell. Printed circuit, 3½in. × 3½in.

CAN BE BUILT FOR **£5.12.9** Post 3/6.

Full details and illustrations post free on request.

Demonstrations at both addresses.

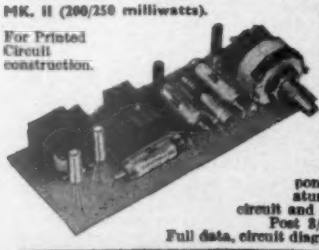
NOTE.—This Tuner in conjunction with our Transistor Amplifier (see below) makes an excellent Transistorised radio. Cabinets available.



LASKY'S TRANSISTOR AUDIO AMPLIFIER

MK. II (200/250 milliwatts).

For Printed Circuit construction.



Size 5½ × 2 × 1½in. weight 4½ oz. excluding battery. Uses our hermetically sealed Transistors and operates from 6 v. battery. Output imp. 3 ohms.

COMPLETE KIT

including 4 Transistors, all brand new components, latest T.C.C. miniature condensers, printed circuit and full instructions. **79/6** Post 3/6.

Full data, circuit diagram, etc., 1/- post free.

ALL TYPES OF CHASSIS

We hold the largest selection.

Leading makes including all models ARMSTRONG, EMPRESS, DULCI, etc.

A.M. chassis, I, M, S...from **7 Gns**
A.M./F.M. chassis from **14 Gns**
A.M./F.M. STEREO from **22 Gns**

DULCI HI-FI CHASSIS TUNERS and AMPLIFIERS

New designs including:—
Mdl. H.4. AM/FM Radiogram Chassis, 4 wavebands, including V.H.F. **£24/6/6**
Mdl. H.4.PP. AM/FM Radiogram chassis, 4 waves including V.H.F. 6-8 watts o.p. push-pull, ultra linear **£29/3/10**
Mdl. H4T/2. Self-powered AM/FM Tuner **£24/19/-**
Mdl. H4T. Self-powered AM/FM Tuner **£20/19/-**
Dulci FM Tuner ... **£17/10/3**

TELETRON "COMPANION"

NOW ON PRINTED CIRCUIT
3-TRANSISTOR POCKET RADIO. T.R.F. circuit covering med. and long waves, with balanced armature output. Ferrite aerial. Size 4¼ × 3 × 1in. CAN BE BUILT FOR ONLY **99/6**
Full instructions and price list 6d. post free.

CONDENSERS, RESISTANCES. High stability Resistances. Electrolytics. All values and sizes stocked.

SPEAKER COVERINGS. Large stocks of Tygan and "Somewaves." Any size piece cut. Samples and prices post free.

JASON F.M. TUNER

Special Parcel containing data book, chassis, front panel, dial, drive, tuning condenser full sets of coils, I.F.s, ratio detector etc. Post 2/6. DATA BOOK with price list, 2/-. This tuner can be built for £6/15/-, post 3/6.

Also in stock JASON "ARGONAUT" AM/FM TUNER and JASON "MEZZURT" switched Tuner. Data Books 2/- each, post free.

LASKY'S F.M. TUNER

PRINTED CIRCUIT VERSION OF G.E.C. 912 "FM. PLUS" TUNER FOR HOME CONSTRUCTION

Uses 5 valves, 2 germanium diodes and brand new T.C.C. condensers. The PRINTED CIRCUIT ensures that the I.F. and R.F. amplifiers are extremely stable at maximum gain and results are consistent on all tuners.

CAN BE BUILT FOR (including valves) **£7.19.6** Post Free.

G.E.C. FM TUNER BOOK plus our full data and Shopping List. 2/6 post free.
All parts available separately.
ALIGNMENT SERVICE available

ALL TYPES F.M. TUNERS
DULCI, QUAD, LEAK, ROGERS, etc.

LASKY'S RADIO

The new PULLIN "100" MULTI-RANGE TEST SET

Built on printed circuit. 21 basic self-contained ranges A.C./D.C. voltage, current and resistance, 10,000 ohms per volt (A.C. and D.C.). Basic movement, 100 microamps. Complete with leads.

£12.7.6 Post & Pkg. 4/6.

Available on hire purchase terms to suit you.

POCKET VOLT TEST METERS. Two ranges D.C. 0-250 v. and 0-25 v. With leads in leather case, 12/6. Post free.

TRANSISTORS

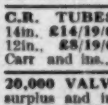
AUDIO P.N.P. Junction Type suitable for high gain and low freq. amplifiers, and for output stages up to 250 milliwatts. (Double spot—yellow and green.) **7/6**
3 for 20/-; 6 for 37/6, post free.

R.F. P.N.P. Junction Type suitable for medium and low freq. oscillators, freq. changers and I.F. amplifiers (1.5 to 8 Mc/s). **15/-**
(Double spot—yellow and red.)
2 for 40/- 6 for 75/-.
Special prices for larger quantities.

MULLARD Transistors. OC44 40/-; OC45 35/-; OC76 or OC71 21/-; OC72 or OC73 30/-; OC16 80/-.

BRIMAR Transistors. TS1 or TS2 12/6; TS3 15/-; TS4 27/6; TF1 or TF2 40/-; TJ1 15/-; TJ2 16/6; TJ3 19/6.

"GOLDTOP" POWER TRANSISTORS



All types now in stock, details on request. Example: V15/10P as illus., ideal for output stage of car radio, will give approx. 3 watts operating from 12v. Each 17/6. Post free.
Output Transformer to suit, correct ratio, matched to 3 ohms, 9/6. Post 1/-.
Driver Transformer 9/6. Post 1/-.

C.R. TUBES, new unused. 14in. £14/19/6; 17in., £16/19/6; 12in., £8/19/6; 9in. £5/17/6. Carr and ins., 22/6.

20,000 VALVES. Brand new surplus and imported, also full stocks of B.V.A. valves and C.R. Tubes. List post free.

TURRET TUNERS. All types—Cyldon, Brayhead, Telenge, Valradio. Describe your set and we will quote you. Prices from 79/6.

RADIO PARCELS

No. 1. Everything to build a 4-valve 2-wave superhet for 200/250 v. A.C. mains. Can be built for £7/10/6.

No. 2. Everything to build a T.R.F. 3-valve set for 200/250 v. A.C. mains. Med. and long wave. Can be built for £5/10/-. Carr. and pkg. 2/6.

Instruction Book for either above, 1/-.

OPEN ALL DAY SATURDAY
Early Closing Thurs., 1 p.m.
(Both addresses)

LASKY'S HARROW ROAD LTD.

42 TOTTENHAM COURT ROAD, W.1.
Nearest Station Goodge Street
MUSeum 2605

370 HARROW ROAD, PADDINGTON, W.9.
(Opposite Paddington Hospital)
LAD 4675 and CUN 1979

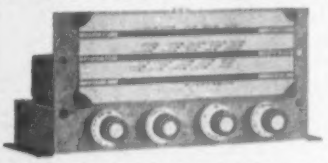
PROMPT POST SERVICE
Please address Mail Orders to Harrow Road

AUTO-CHANGERS
GOLLARO RG64 3 SPEED MIXER

Fitted studio pick-up with turnover head. Brand new, cartoned, but for 110 v. 50 c.p.s. A.C. mains. So that the unit can be operated from normal 200-250 v. A.C. mains we are supplying free with every changer a suitable auto-transformer with input and output voltages clearly marked. Limited number only. **£5/19/6.** Carr. 5/6.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012. 10 watts 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. **£4/10/9.** Please state whether 3 ohm or 15 ohm required.



AM/FM RADIOGRAM CHASSIS, HIGH QUALITY. PUSH-PULL. 6-8 WATTS OUTPUT. Current manufacture. 12 months' guarantee. For 200-250 v. mains. Covers L. and M. Wavebands plus F.M. Includes 8 latest type miniature B.V.A. valves. Only **22 gns.** plus 7/6 carr. Or deposit £3/12/- and 9 monthly payments of £2/12/-.

AM/FM RADIOGRAM

29½ GNS.

By leading manufacturer. Brand new, cartoned 4 wavebands including V.H.F. Auto-changer at 3 speeds. Hi-Fi pick-up with duo point sapphire stylus. For 200-250 v. 50 c.p.s. A.C. mains. Limited stocks at a fraction of listed price. Only **29½ gns.** Or Deposit **£5/19/6** and 9 monthly payments of **£3 gns.** Carr. 10/-

THE SKY FOUR T.R.F. RECEIVER

A design of a 3 valve 200-250 v. A.C. Mains. L. & M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, 6P61, 6P6G and is specially designed for simplicity in wiring. Sensitivity and quality is well up to standard. Point-to-point wiring diagrams, instructions and parts list, 1/9. This receiver can be built for a maximum of **£4/19/6** including cabinet. Available in brown or cream bakelite or veneered walnut.

L3/3A STEREOPHONIC GRAM. AMPLIFIER

Designed to fit in most Portable Cabinets. Outputs 3 watts on each channel (Total 6 watts). Sensitivity 130 m.v. Controls Volume (Ganged) Tone (Ganged) and Balance. For 200—250 v. A.C. mains. Output sockets for two 3 ohm speakers. **£6.19.6**

STEREOPHONIC SOUND EQUIPMENT AT KEEN PRICES

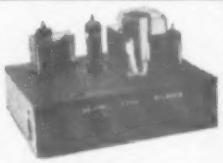
Staar Galaxy 4-speed Auto-changer, fitted Acos Turnover Stereo head for standard 78 r.p.m., L.P. and Stereo records. Carr. 4/6 **£8/19/6**

Matched speakers in polished wood cabinets, walnut finish, 6½in. P.M. £3/5/- per pair. 8in. P.M., 12,000 lines, £3/19/9 per pair. 12in. P.M., 12,000 lines, £9/15/- per pair.

SPECIAL OFFER. Staar Changer with Stereo head, Linear 3+3 watt Stereo amplifier and pr. 6½in. cabinet speakers. **17 gns.**

Or with pair 8in. cabinet speakers **18 gns.** Or with 12in. speakers in cabinets **22 gns.** Carr. 15/-.

LINEAR STEREOPHONIC AMPLIFIER L3/3. Sensitivity 150 m.v. for 3 watts output on each channel. Ganged Vol. and Tone Controls. Preset balance control. Outputs for two matched 2-3 ohm speakers. (Can be used as straight 6-watt amplifier.) Provides remarkably realistic output when connected to 200-250 v. A.C. mains point. Stereophonic pick-up head and good quality speakers. Instructions and guarantee included. Carr. free **7 gns.** Send S.A.E. for leaflet.



COLLARO 4-SPEED AUTO-CHANGERS With studio pick-up with turnover head. BRAND NEW. Cartoned latest model. For 200-250 v. A.C. mains. Very limited number. Conquest **£7/19/6.** Continental **9 gns.** Carr. 5/6.

ACOS Crystal Microphone Inserts. Brand new. Only 5/11 ea.
ACOS HGP59 Hi Fi Crystal Cartridges. (Turnover type with sapphire stylus.) Standard replacement for Garrard and B.S.R. Only 19/9.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all dry battery eliminator. Size 5½ × 4½ × 2in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagram. 39/9 or ready for use 46/9.

Type BM2. Size 8 × 5½ × 2½in. Supplies 120 v. 90 v., and 60 v. 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2 v. ACCUMULATORS** when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator. Complete kit with diagrams and instructions, 49/9, or ready for use, 59/6.

R.S.C. TRANSFORMERS

FULLY GUARANTEED. **INTERLEAVED AND IMPREGNATED**

MAINS TRANSFORMERS
Primaries 200-230-250 v. 50 c/s.

FULLY SHROUD UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a., suitable for Mullard 510 Amplifier	33/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t., 5 v. 3 a.	49/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9

ELIMINATOR TRANSFORMERS
Primaries 200-250 v. 50 c/s.

120 v. 40 mA., 5-0-5 v. 1 a.	14/9
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS
Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.	5/9	6.3 v. 3 a.	8/11
6.3 v. 2 a.	7/6	6.3 v. 6 a.	17/6
0-4-6.3 v. 2 a.	7/9	12 v. 3 a. or 12 v. 1 v.	7/9
		24 v. 1.5 a.	17/6

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3B4, etc.	3/6
Small Pentode 5,000Ω to 3Ω	3/9
Standard Pentode 5,000Ω to 3Ω	4/6
Standard Pentode 8,000Ω to 3Ω	4/9
Push-pull 8 watts 6V6 to 5 ohms	8/9
Push-pull 10-12 watts 6V6 to 3Ω or 15Ω	15/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-pull EL84 to 3 or 15 ohms	16/9
Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc., to 3 or 15 ohms	21/9
Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω	47/9

SMOOTHING CHOKES

250 mA., 5 H., 100 ohms	11/9
150 mA., 7-10 H., 250 ohms	11/9
100 mA., 10 H., 200 ohms	8/9
80 mA., 10 H., 350 ohms	5/6
60 mA., 10 H., 400 ohms	4/11
1 amp. 0.5 ohm. L.T. type	6/6

SELENIUM RECTIFIERS

L.T. Types

2/6 v. ½ a.h.w.	1/9
6/12 v. ½ a.h.w.	2/9

F.W. Bridge

6/12 v. 1 a.	3/11
6/12 v. 2 a.	7/3
6/12 v. 3 a.	9/9
6/12 v. 4 a.	13/11
6/12 v. 5 a.	14/6
6/12 v. 6 a.	14/11
6/12 v. 10 a.	25/9
6/12 v. 15 a.	35/9
24 v. 6 a.	35/9

H.T. Type H.W.

120 v. 40 mA.	3/9
250 v. 50 mA.	5/9
250 v. 80 mA.	7/9
250 v. 250 mA.	10/9

BATTERY CHARGING EQUIPMENT

ASSEMBLED CHARGERS

6 v. 1 a.	19/9
6 v. 2 a.	29/9
6/12 v. 1 a.	27/9
6 /12v. 2 a.	38/9
6/12 v. 4 a.	56/9

Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. & pkg. 3/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.
Secs.: 0-9-15 v. 1½ a., 11/9; 0-9-15 v. 3 a., 16/9; 0-9-15 v. 5 a., 19/9, 0-9-15 v. 6 a., 23/9.

BATTERY CHARGER KITS
Consisting of Mains Transformer F.W. Bridge. Metal Rectified, well ventilated steel case. Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 2/6 extra.

6 v. or 12 v. 1 amp.	22/9
as above, with ammeter	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. (inclusive of ammeter)	41/6
6 v. or 12 v. 4 amps.	53/9

BATTERY CHARGER KIT 6/12 v., 6 amp., consisting of F.W. Bridge Rectifier Mains Trans. and ammeter. 49/9. Post 4/6.

ASSEMBLED CHARGER
6 v. or 12 v.
2 amps.

Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **49/9** Carr. 3/6.

All for A.C. Mains 200-250 v. 50 c/s. Guaranteed 12 months

ASSEMBLED 6v. or 12v. 4 amps.

Fitted Ammeter and variable charge selector. Also selector plug for 6v. or 12v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads. Carr. 4/6. Or Deposit 14/11 and five monthly payments 14/11. **75/-**

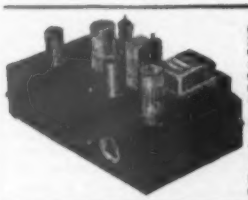
As above but for 6 amp charging. 5 GNS. Carr. 5/-. Or Deposit 19/9 and five monthly payments of 19/9.

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolts minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram, etc., etc., can be simultaneously applied for mixing purposes. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 a. FOR A RADIO FEEDER UNIT.** Price in kit form with easy-to-follow wiring diagrams. Only **11 Gns.** Cover as illustrated 18/9 extra. Carr. 10/-.

Or Factory built with 12 months' guarantee **£13/19/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 36/9** and 9 monthly payments of **31/9.**

Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ± 3 D.B. 30-20,000 c/cs., Tone Controls ± 12 D.B. at 50 c/cs., + 12 D.B. to − 6 D.B. at 12,000 c/cs., Hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12 × 9 × 9in. approx. Power consumption 150 watts. For A.C. mains 200-250-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS, or OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.**



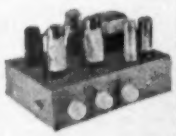
LINEAR LT/45 HIGH QUALITY TAPE DECK AMPLIFIER COMPLETE with POWER PACK and ONE STAGE. Suitable for Collaro-Lane, Truvox, Brennell etc., etc. State make of Deck when ordering. Chassis size 12-7-3in. Overall size 12-7-4½in. For 200-250 v. 50 c/cs. A.C. mains. Output for standard 2-3 ohm speaker. Only 15 millivolts input required for full recording. Only 8 millivolts minimum output required from recording head. Magic Eye recording level indicator. Provision for feeding P.A. amplifier. Negative feed-back equalisation. Linear frequency response ±3 D.B 30-11,000 c/cs. Facilities for recordings at 1⅞in., 7½in. or 3¾in. per second. Automatic equalisation at the turn of a knob. When switching from record to playback position automatic demagnetisation of heads is assured. Separate gain and output controls. Valves type ECC83, ECC83 EL84, EZ80, EM34 Output 4 watts. Unit supplied with maker's 12 months' guarantee. We know of no other make which represents the same exceptional value. Leaflet 6d.

12 GNS. Ready for use Carr. 7/6

COLLARO JUNIOR 4 SPEED RECORD PLAYER with separate pick-up having dual point sapphire stylus. Brand new, cartoned. For 200-250 v A.C. mains only. Only **£4/10/-.** Post 3/6.

LG3 MINIATURE 3 WATT GRAM. AMPLIFIER For 200-250 v 50 c.p.s. A.C. Mains. Overall size only 6¼ × 4½ × 2¾in. Fitted vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohms speaker. Guaranteed 12 months. Only **55/9**

R.S.C. AS 4.5 WATT HIGH GAIN AMPLIFIER



A highly sensitive 4-valve quality amplifier for the home, small club etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible being 71 D.B. down. 18 D.B. of negative feedback is used. H.T. of 200 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive, KB is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only **84/15/-** or assembled ready for use **25/-** extra, plus 5/6 carriage. Or Deposit **22/-** and five monthly payments of **9/2/-** for assembled unit.

R.S.C. A7 3-4 WATT QUALITY AMPLIFIER

A highly sensitive 4-valve amplifier using negative feedback and having an excellent frequency response. Pre-amplifier and Tone Control stages are incorporated with separate Bass and Treble controls giving full bass compensation for long playing records. Suitable for any kind of pick-up including latest high fidelity types. H.T. of 250 v. 20 mA. and L.T. 6.3 v. 1 a., available for supply of Radio Feeder Unit, etc. ONLY 40 millivolts input required for full output. Fully isolated chassis with baseplate. For A.C. mains 200-250 v., 50 cycles. Output for 2-3 ohms speaker. Complete kit of parts, point-to-point wiring diagrams and instructions. Only **63/15/-**, carr. 2/6 or factory built **25/-** extra.

SENSATIONAL OFFER
STAAR GALAXY 4-SPEED MIXER AUTO-CHANGER

A precision manufactured unit with unique fingertip control. Pick-up fitted with dual sapphire tipped stylus. A very compact changer in attractive dual-tone finish. For A.C. mains 110—250v. Brand new, cartoned **£4/19/6.** *Post 4/6*

ACOS HIGH FIDELITY PICK-UPS. GP54 with BGP59/62 cartridge. Dual point sapphire styles. Cream finish. A fortunate purchase enables us to offer these at approx. half price. Only **35/9**

PORTABLE CABINETS. Inside measurements 17 × 13½ × 9½in. high. Clearance above baseboard 3½in. Below 9½in. Attractive design. Two tone ravine covering. Carr. 3/-. Only **69/9**

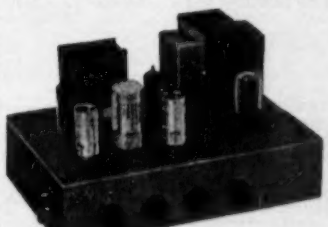
SPECIAL OFFER. Above cabinet, LG3 amplifier, 6½in. P.M. speaker and Staar Galaxy Autochanger, **11 GNS.** Carr. 10/-.

LINEAR LG3 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with Garrard R.S.L. or any other record playing unit and most microphones. Negative feedback 12 D.B. Separate Bass and Treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves used. Size only 6 × 5 × 5½in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **65/19/6.** Or Deposit 20/-, and five monthly payments of **22/-.** Send S.A.E. for leaflet.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms), consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with chokes and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only **85/17/6.** Or Deposit 13/- and nine monthly payments of 13/-.

All ULTRA LINEAR 12-14 WATT AMPLIFIER



NEW 1958 DESIGN HIGH-FIDELITY PUSH-PULL AMPLIFIER WITH "BUILT-IN" TONE CONTROL PRE-AMP. STAGES

Two input sockets with associated controls allow mixing of "mike" and gram, as in A10. High sensitivity. Includes 5 valves, ECC83 ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ±3 DB 30-30,000 c/cs. Six negative feedback loops. Hum level 60 DB down ONLY 32 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For **STANDARD** or **LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS,** etc. **OUTPUT SOCKET** with plug provides 300 v 20 m.a. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx 12-9-7in. For A.C mains 200-230 v 50 c/cs Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built **45/-** extra).

If required louvred metal cover with 2 carrying handles can be supplied for **12/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 25/6** and nine monthly payments of **25/6.** Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones, etc., with cash and credit terms.

LINEAR "DIATONIC" 10-WATT HIGH FIDELITY AMPLIFIER. Incorporating pre-amp. For A.C. mains, input 200-250-250 v. 50 c.p.s. A compact attractively finished unit with two separately controlled inputs and outputs for 3 and 15 ohms speakers. Separate Bass and Treble controls. Five latest type miniature Mullard valves. Only **12 Gns.** Send S.A.E. for leaflet and credit terms.

P.M. SPEAKERS

2-3 ohm 9in. Rola 17/6. 8in. Goodmans 17/9. 7 × 4in. Elliptical 19/9. 6½in. Rola 19/9. 8in. Rola 19/9 8in. Goodmans 21/9. 10in. R.A. 25/9. 10 × 6in. Elliptical Goodmans 26/9. 12in. Plessey 39/11. 12in. Plessey 3 or 15 ohms, 10 watts, 12,000 lines, 59/6.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode Frequency is used. Pentode I.F. and double Diode Second Detector, delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W.Cs. Sw. incorporates Gram. position. Controls are Tuning, W. Cb. and Vol. Output will load most Amplifiers requiring 250 mV input depending on Ae location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is **84/15/-.** Point-to-point wiring diagrams and instructions, 2/6.

Radio Supply Co. (LEEDS) LTD.

Personal Shoppers to 5 and 7, County Arcade, Briggate, Leeds, 1.
Mail Orders to 29-31, Moorfield Road, LEEDS, 12.

Terms: C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra on all orders under £2. 2/9 extra under £5 unless carriage charge stated. Full Price List 6d. Trade supplied. Open to callers: 9 a.m. to 6 p.m. Wednesday until 1 p.m. S.A.E. please with all enquiries.

RADIO SUPPLY CO. (LEEDS) LTD.

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Terms C.W.O. or C.O.D. No C.O.D. under £1. Post, 1/9 under £2, 2/9 under £5 unless quoted. Open 9—4 p.m. Weds. until 1 p.m.

CO-AXIAL CABLE. 75 ohms, ¼in., 8d. yard. Twin screened feeder 11d. yard.

ELECTROLYTICS (current production) Not Ex Govt.

Tubular Types		Can Types	
8 mfd. 450 v.	1/9	16μF 450 v.	2/9
8 mfd. 500 v.	2/6	32μF 350 v.	2/11
16μF 350 v.	1/11	32 mfd. 450 v.	4/9
16μF 450 v.	2/9	100 mfd. 450 v.	4/9
16μF 500 v.	3/9	8-8μF 450 v.	2/11
25μF 25 v.	1/3	8-16μF 450 v.	3/11
50μF 12 v.	1/3	16-16μF 450 v.	4/11
50 mfd. 25 v.	1/9	16-32 mfd. 350 v.	4/6
50μF 50 v.	1/9	32-32μF 350 v.	4/9
100 mfd. 12 v.	1/9	32-32μF 450 v.	5/9
100 mfd. 25 v.	2/3	100-100 mfd. 350 v.	5/9
3,000 mfd. 6 v.	3/9	150 mfd. 450 v.	5/9
6,000 mfd. 6 v.	3/11	100-200 mfd. 275 v.	6/11

VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

EX GOVT. STEP UP/STEP DOWN TRANSFORMERS. Double wound. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or Reverse. 300 watts, 35/9, plus 7/6 carr.

2 v. 16 A.H. EX GOVT. ACCUMULATORS New, boxed. Only 5/6 each, 3 for 15/-, plus 2/6 carr., 6 for 27/6. Carr. 3/6.

D.C. SUPPLY KITS. Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s.; 12 v. lamp selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case, and circuit. Very limited number, 29/9.

VIBRATORS. Oak and Wearite, synchronous 7 pin, 2 v. 7/9, 6 v. 8/9.

JUNCTION TRANSISTORS. R.F. type 17/6. Audio type 7/9.

EX GOVT. METAL BLOCK PAPER CONDENSERS. 8 mfd., 10 mfd. 500 v. 3/9. **INSULATED STAPLES** ¼in. Boxes of 100. Only 1/- each. 10/6 doz. £5/10/- gross.

LINEAR 50 WATT HIGH FIDELITY AMPLIFIER
Sensitivity 25 millivolts for full output. Suitable for any kind of Microphone or pick-up. Output matchings for 3 ohm and 15 ohm speakers. Brand new, cartoned. Guaranteed 12 months. For 200-250 v. 50 c.p.s. A.C. mains. Only 19 gns. Carr. 15/-. Or Deposit 3 gns. and 9 monthly payments of 42/3. Suitable cover with 2 carrying handles available at 19/6.

12in. 10 WATT HIGH QUALITY LOUDSPEAKERS IN POLISHED WALNUT FINISHED CABINET.

Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4/19/6. Carr. 5/-.
Terms: Deposit 11/- and 9 monthly payments of 11/-.

EX GOVT. MAINS TRANSFORMERS
All 200-250 v. 50 c/s input.

250-0-250 v. 60 mA., 6.3 v. 3 a., 6.3 v. 1 a. Potted 4½-3½-3in.	11/9
Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v. 7 a., 5 v. 3 a.	22/9
230-0-230 v. 80 mA. 12.6 v. 1.5 a., 5 v.2 a.	11/9
250-0-250 v. 150 mA 5 v. 3 a.	16/9
350-0-350 v. 160 mA. 6.3 v. 5 a., 5 v. 3 a.	27/9
400-0-400 v. 250 mA. 5 v. 2 a., 5 v. 2 a..	18/9
450-0-450 v. 250 mA. 6.3 v. 3 a., 6.3 v. 1 a., 5 v. 6 a.	49/9
12.5 v. 3 a., 5 v. 3 a.	12/9
0-24-26-28 v. 15 amps. A.C. conservative Gov. rating (marked with D.C. rating after rectification) 69/9. Carr. 15/-.	
0-10-20-25 v. 24 a. (Gov. rating) 79/6. Carr. 15/-.	

EXTENSION SPEAKERS
Limited number in handsome Walnut veneered cabinets. 2-3 ohm speech coils. 6½in. 29/9. 8in. 35/9.

MANUFACTURERS' SURPLUS TRANSFORMERS. Primary 230-250 v. Universal mtg. 350-0-350 v. 100 mA. 6.3 v. 4 a. C.T. 0-4-5 v. 3 a. 18/9. Post 2/9.

EX GOVT. SMOOTHING CHOKES

250 mA., 20 H., 150 ohms	19/6
200 mA., 3-5 H., 50 ohms. Parmeko	9/9
150 mA., 10 H., 50 ohms	10/11
150 mA. 6-10 H., 150 ohms, trop.	6/9
120 mA., 12 H., 100 ohms	9/9
100 mA., 10 H., 100 ohms	6/9
100 mA., 5 H., 100 ohms, tropicalised	3/11
80 mA., 20 H., 900 ohms	6/9
60 mA., 5-10 H., 250 ohms	2/11

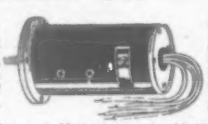
EX GOVT. CASES. Well ventilated, black crackle finished, undrilled cover. Size 14 × 10 × 8¼in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE, COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post. **SPECIAL OFFERS.** Small 2 gangs .0005 mfd., 4/9. Electrolytic Cans. 150 mfd. 450 v 3/9 ea. Lots of six 19/6.

BRAND NEW LUCAS MOTOR-CYCLE BATTERIES. 6 v. 22 A.H. (In sealed cartons.) Limited number available at only 29/9 each. Carr. 3/6. Normal price 71/- each.

14 WATT HI-FIDELITY AMPLIFIERS. For any type of pick-up and Mike. Store soiled but tested and guaranteed in perfect order. For 200-250 v A.C. Mains. Complete with 8 latest type valves. Only 6gns. carr. 7/6.

MIDLAND INSTRUMENT CO.

HUGHES MOTORS, shunt wound, 12-v. 1½-amp., speed 5,000 r.p.m., reversing, size 3¼in. long, 1¼in. dia., ¼in. shaft, weight 20 oz., a very superior motor designed for anti-radar equipment, new, unused, 10/-, post 1/6. Ditto fitted reduction gear, giving a final drive (¼in. shaft) of either 320 or 160 r.p.m., state which required, 12/6, post 1/9.



BAKER & STROUD RANGEFINDERS. 1-metre base, coincidence type, a hand-held instrument that gives range in yards of any distant object from 500 to 20,000 yards (12 miles). The variable focus 14 × right eyepiece provides two images of the object viewed: one from the right objective the other from the left. When these two images are brought into coincidence the range in yards can immediately be read in the left eyepiece. Fitted two filters and other refinements. A very high-quality instrument, original cost £180, our price new or near new condition, supplied in stout fibre containers, £5, carriage 100-m. 7/6, 200-m. 10/-, 300-m. 12/6, N.I 20/-.

CHASSIS. U.S. manufacture all aluminium, 12½ × 8 × 3½in. complete with top cover, some items have been removed, remaining are:—25 Amp-wound midget ceramic B7G type v/holders, complete with cans, over 70 colour coded 5% resistors, also many ceramicons and other combs., trimmers, ,adders, fixed and variable inductances, transformer, v/control, etc., new, unused, bargain, 10/-, post 3/6.

ZAMBONI PILES, dry voltaic type, consists of 2 piles, each 6in. long by 1in. dia. in high insulation mount to give 1000-v., taken from new unused infra-red receivers 5/-, post 1/6, also variable focus eyepieces and Written filter backed objectives taken from same instrument, 5/- set, post 1/6.

RELAYS, all new unused. U.S. type, 7000-ohms, single pole make, size 2½ × 2 × 1¼in., 3/6, post 9d., ditto 40-ohms, 2-pole 2-make, size 1½ × 1½ × 1in., 2/6, post 9d. Siemens H.S. relays, 145-ohms, single-pole changeover platinum contacts, in metal cases with terminal block, 5/-, post 1/6, SC/449 relays, 20-ohms, 9-14 v., single make, 40-amp. D.C. contacts, in Bakelite cases, 2½ × 2½ × 1¼in., 2/6, post 1/-.

SIGHTING TELESCOPES by Ross, Taylor, Hobson, etc., these high quality instruments contain four 40 mm. dia. achromats, 2 of 3in. focal length, 2 of 3½in. focal length, also an 18 mm. dia. image erector achromat, 4 screw fine adjustment cross graticule, length 16in., weight 7lb., new and boxed, 25/-, post 3/3.

TELEPHONE SETS, consist of two combined microphones and receivers, which when wired up by ordinary twin flex, provide perfect 2-way communication, excellent results at 1 mile range have been reported, self-energised, no battery required, set complete, new unused, 7/6, post 1/3; suitable twin 14/36 p.v.c. up to 200ft. lengths at 1d per ft. supplied, postage each 200ft. flex 2d. extra.

SELENIUM RECTIFIERS. These are latest brand new G.E.C. supply, not ex-Govt., or assembled from bits, full-wave bridge 12-v. 1½ amp. cont., 2 amp. int., 10/-, post 1/-; ditto, 12-v. 2 amp. cont., 4 amp. int., 15/-, post 1/6; mains transformers to suit 200/230/250-v., with 8-11-17 v. outputs to charge a 2, 6 or 12 v. battery, brand new, 1½ amp. type, 15/-, post 1/9; 3 amp. type, 20/-, post 2/3, complete with wiring diagram.

MOTOR GENERATORS. 4½in. long, 3½in. dia., weight 5lb., totally enclosed, black crackle finish, input 27 v., 1.5 amps., output 200 v., 60 m/A. from 12 v. output is approx. 130 v. at 40 m/A., ideal for operating electric razors from 12 v. car battery, new, unused, 12/6, post 2/-.

GRAMOPHONE MOTORS, dual voltage 100/130 v., 200/250 v. A.C. mains, size 9½ × 3 × 1¼in., weight 18 oz., ¼in. long, ⅛in. dia. shaft, speed 1,350 r.p.m., rubber bushed mounting bracket, a superior motor of recent manufacture, brand new, boxed, 15/-, post 1/6.

Many other Bargains; send stamped addressed envelope for lists.

MIDLAND INSTRUMENT CO., MOORPOOL CIRCLE, BIRMINGHAM, 17

Tel.: HAR 1308

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FULL FREQUENCY STEREOPHONIC SOUND

A NEW AND VERY EXCITING EXPERIENCE IN LISTENING WHICH HAS COME TO STAY.

SPECIAL BARGAIN OFFER!

One pair of matched Deccamatic III amplifiers, made by the famous Decca Co., known to all music lovers throughout the world. Very sturdily built, finest possible components, tapped mains transformer, metal rectifier, Mullard ECL82 sound amplifier and output valve and twin spring loaded white knobs. Measurements: 8¼in. x 3in. x 3¼in., complete with one pair of matched Celestion speakers (elliptical) of the very latest design. Supplied complete with all leads, ready to connect to your Stereophonic pick-up. Full operating instructions enclosed with each Unit.

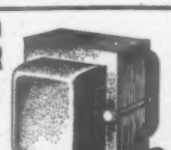
COMPLETE £10/10/- only. P. & P. free.

Send S.A.E. for our very latest list of Radio, Television and Electrical components and equipment.

J. R. SEXTON LTD.

162, Grays Inn Road, London, W.C.1. *Tel. TERminus 0228-9*

TRANSFORMERS FOR MULLARD 510 AND STEREOPHONIC AMPLIFIER



ALL TRANSFORMERS. Fully guaranteed. Shrouded. Upright mounting, interleaved and impregnated. Primaries on all mains Trans. 200—220—240 : 0—10 v. 50 c/s.

T.10/1. For two 510 amps, low loading (6,000 ohm output trans.) 300-0-300 v., 150 mA., 6.3 v. 4 a. c.t., 6.3 v. 1 a., 24/-. P. & P. 2/9.

T.5A. For 510 Amp and Tuner, 300—0—300v., 150 mA., 6.3v. 2.5a.c.t., 6.3v. 2.5a., 6.3v. 1a. 22/-. P./P. 2/6.

T.9B. For 510 amp, 300—0—300v., 100mA., 6.3v. 2.5a.c.t., 6.3v 1a., 27/-. P./P. 2/6.

T.44. "510" Ultra Linear Output Trans. 6000 ohms. 43% tappings. 20/-. P./P. 2/-.

T.100. "510" Low Loading Output Trans. 6000 ohm. (not Ultra Linear). 22/-. P./P. 2/-.

SPECIAL OFFERS. T.44 and T.55. 50/-. P./P. 3/6.
ONE T.101 and TWO T.100's for Stereo Amplifier. 39/-. P./P. 3/6.

"POWER-PAKS"
Two new high efficiency mains transformers and contact cooled metal full-wave bridge rectifiers. 270 volts D.C 60-100mA. 6.3v 2-3 amps c.t. write for full details.

SOUTHERN TECHNICAL SUPPLIES, 63 Station Road, Portslade, Sussex

AMPLIFIERS PRE-AMPLIFIERS

COMPLETE KITS OF PARTS FOR THE "HI-FI" ENTHUSIAST

Designed by MULLARD—Presented by US strictly to their specification

MULLARD DESIGNS FOR THE HOME CONSTRUCTOR

THE VERY POPULAR MULLARD "5-10" MAIN AMPLIFIER

Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-Amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "Hi-Fi" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S SPECIFICATION with specified valves and components and including the latest PARMEKO Ultra-linear Output transformer and the Parmeko mains transformer which has power available to drive Radio Tuning Unit.

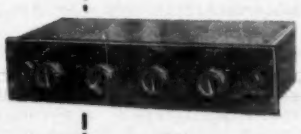
Price for COMPLETE KIT OF PARTS **£10.0.0**

Alternatively we supply ASSEMBLED and TESTED **£11.10.0**

(Carriage and insurance 5/- extra.)

We also offer this "5-10" incorporating the latest PARTRIDGE ULTRA-LINEAR OUTPUT TRANSFORMER for £1/6/- extra.

MULLARD'S NEW 2-STAGE PRE-AMPLIFIER TONE CONTROL UNIT



A completely new design employing two EF86 valves, and in particular designed to operate with the Mullard range of Power Amplifiers, but also perfectly suitable for other makes.

Briefly it incorporates:—

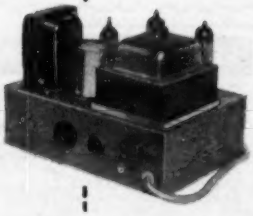
- Equalisation for the latest R.I.A.A. characteristics.
- Input for variable reluctance. Magnetic Pick-ups.
- Input for Crystal Pick-ups.
- Input for Tape replay.
  - (a) Direct from High Impedance Tape Head.
  - (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel.
- Wide range BASS and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION.

Price COMPLETE KIT OF PARTS **£6.6.0**

Alternatively we supply ASSEMBLED and TESTED **£8.0.0**

(Carriage and Insurance 5/- extra.)

THE NEW MULLARD "3-3" MAIN AMPLIFIER



Based entirely on the present very popular "3-3" model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown here) thus providing all the facilities associated with the more extensive "Hi-Fi" equipment. We recommend it as the IDEAL SMALL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts).

We supply considerably to MULLARD'S SPECIFICATION INCLUDING the latest PARMEKO Output Transformer specified Valves and Components. Has Power available to drive a Radio Tuning Unit.

Price for COMPLETE KIT of PARTS **£7.0.0**

Alternatively we supply ASSEMBLED and TESTED **£8.0.0**

(Carriage and Insurance 5/- extra.)

Special Price Reductions WE OFFER

Only NEW HIGH GRADE Components and Mullard Valves are supplied with these kits—we DO NOT use "Surplus or Cheap" components.

(a) THE COMPLETE KIT of PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-stage PRE-AMPLIFIER-CONTROL UNIT **£12.10.0**

(b) THE COMPLETE KIT of PARTS to build both the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£15.15.0**

"ALL PRICES QUOTED FOR THE "5-10" ARE SUBJECT TO £1/6/- EXTRA IF THE PARTRIDGE TRANSF. IS REQUIRED.

Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required . . . alternatively the COMPLETE ASSEMBLY MANUALS containing component Price Lists and practical Drawings etc. are available at 1/6 each.

(a) THE "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£15.0.0**

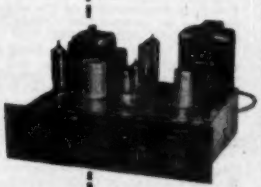
H.P. TERMS: DEP £3 and 12 monthly payments of £1/2/- or DEP. £5 and 12 monthly payments of 19/4.

(b) THE "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£18.18.0**

H.P. TERMS: DEP. £3/10/- and 12 monthly payments of £1/7/8 or DEP. £5/8/- and 12 monthly payments of £1/3/1.

When ordering please include an extra 7/6 to cover the cost of carriage and insurance

THE NEW COMPLETE MULLARD "5-10" AMPLIFIER



We offer this popular and very successful design COMPLETE to MULLARD'S SPECIFICATION, but incorporating some improvements in the general layout. HIGH QUALITY REPRODUCTION up to a maximum of 10 watts output. The CONTROL UNIT is separate and completely enclosed; it is normally fitted to the Main Amplifier Chassis as shown in the illustration, but, if it is desired to use the unit remote from the Main Chassis, it can be quite easily detached and used up to 2 yards distance. We incorporate SPECIFIED COMPONENTS and NEW MULLARD VALVES. We also give the purchaser the choice of two of the most ULTRA-LINEAR OUTPUT TRANSFORMERS made—first the latest by PARMEKO LTD., and also the latest by PARTRIDGE (£1/6/- extra) which is generally recognised as the best U/L Output Transformer made today and ensures maximum undistorted output and the widest frequency range. We also supply the PARMEKO MAINS TRANSFORMER, and this has extra power available to supply a Radio Tuning Unit amounting to 250 volts at 25 m.A. and a separate heater winding giving 6.3 volts 2½ amps.

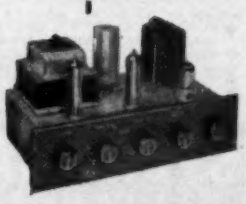
Price COMPLETE KIT OF PARTS (PARMEKO TRANSFORMER) **£11.10.0**

Alternatively we supply ASSEMBLED and TESTED **£13.10.0**

H.P. Terms: Dep. £3/14/- and 12 monthly payments of 19/10.
or Dep. £4/10/- and 12 monthly payments of 14/8.

Send S.A.E. for ILLUSTRATED LEAFLET or 1/6 for the COMPLETE ASSEMBLY MANUAL.

THE NEW COMPLETE MULLARD "3-3"



A VERY HIGH QUALITY 3 WATT AMPLIFIER PROVIDING EXCELLENT REPRODUCTION AND HAVING AN ATTRACTIVE ENGRAVED PERSPEX FRONT PANEL.

Price for COMPLETE KIT OF PARTS (plus 6/6 carriage and insurance.) **£7.10.0**

Alternatively supplied ASSEMBLED and FULLY TESTED **£8.19.6**

(plus 6/6 carriage and insurance).

The complete specification is available for 1/6.

Developed from the very popular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to the Mullard specification including supply of specified components, valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 7" and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

Please enclose S.A.E. with all enquiries

STERN RADIO LTD. 109 & 115 FLEET ST., LONDON, E.C.4
Telephone FLEET STREET 5812/3/4

RADIO SUPPLY CO. (LEEDS) LTD.

(Dept. D) 5 and 7, County Arcade, Briggate, Leeds, 1.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Post, 1/9 under £2, 2/9 under £5 unless quoted. Open 9—6 p.m. Weds. until 1 p.m.

CO-AXIAL CABLE. 75 ohms, ½in., 8d. yard. Twin screened feeder 11d. yard.

ELECTROLYTICS (current production) Not Ex Govt.

Tubular Types		Can Types	
8 mfd. 450 v.	1/9	16μF 450 v.	2/9
8 mfd. 500 v.	2/6	32μF 350 v.	2/11
16μF 350 v.	1/11	32 mfd. 450 v.	4/9
16μF 450 v.	2/9	100 mfd. 450 v.	4/9
16μF 500 v.	3/9	8-8μF 450 v.	2/11
25μF 25 v.	1/3	8-16μF 450 v.	3/11
50μF 12 v.	1/3	16-16μF 450 v.	4/11
50 mfd. 25 v.	1/9	16-32 mfd. 350 v.	4/6
50μF 50 v.	1/9	32-32μF 350 v.	4/9
100 mfd. 12 v.	1/9	32-32μF 450 v.	5/9
100 mfd. 25 v.	2/3	100-100 mfd. 350 v.	5/9
3,000 mfd. 6 v.	3/9	150 mfd. 450 v.	5/9
6,000 mfd. 6 v.	3/11	100-200 mfd. 275 v.	6/11

VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

EX GOVT. STEP UP/STEP DOWN TRANSFORMERS. Double wound. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or Reverse. 300 watts, 35/9, plus 7/6 carr.

2 v. 16 A.H. EX GOVT. ACCUMULATORS New, boxed. Only 5/6 each, 3 for 15/-, plus 2/6 carr., 6 for 27/6. Carr. 3/6.

D.C. SUPPLY KITS. Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s.; 12 v. lamp; selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case, and circuit. Very limited number, 29/9.

VIBRATORS. Oak and Wearite, synchronous 7 pin, 2 v. 7/9, 6 v. 8/9.

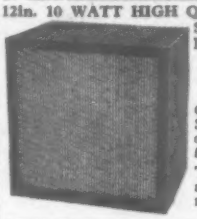
JUNCTION TRANSISTORS. R.F. type 17/6. Audio type 7/9.

EX GOVT. METAL BLOCK PAPER CONDENSERS. 8 mfd., 10 mfd. 500 v. 3/9.

INSULATED STAPLES ½in. Boxes of 100. Only 1/- each. 10/6 doz. £5/10/- gross.

LINEAR 50 WATT HIGH FIDELITY AMPLIFIER

Sensitivity 25 millivolts for full output. Suitable for any kind of Microphone or pick-up. Output matchings for 3 ohm and 15 ohm speakers. Brand new, cartoned. Guaranteed 12 months. For 200-250 v. 50 c.p.s. A.C. mains. Only 19 gns. Carr. 15/-. Or Deposit 3 gns. and 9 monthly payments of 42/3. Suitable cover with 2 carrying handles available at 19/6.



12in. 10 WATT HIGH QUALITY LOUDSPEAKERS IN POLISHED WALNUT FINISHED CABINET.

Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4/19/6. Carr. 5/-.

Terms: Deposit 11/- and 9 monthly payments of 11/-.

EX GOVT. MAINS TRANSFORMERS

All 200-250 v. 50 c/s input.

250-0-250 v. 60 mA., 6.3 v. 3 a., 6.3 v. 1 a. Potted 4½-3½-3in. 11/9

Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v. 7 a., 5 v. 3 a. 22/9

230-0-230 v. 80 mA. 12.6 v. 1.5 a., 5 v. 2 a. 11/9

250-0-250 v. 150 mA 5 v. 3 a. 16/9

350-0-350 v. 160 mA. 6.3 v. 5 a., 5 v. 3 a. 27/9

400-0-400 v. 250 mA. 5 v. 2 a., 5 v. 2 a... 18/9

450-0-450 v. 250 mA. 6.3 v. 3 a., 6.3 v. 1 a., 5 v. 6 a. 49/9

12.5 v. 3 a., 5 v. 3 a. 12/9

0-24-26-28 v. 15 amps. A.C. conservative Gov. rating (marked with D.C. rating after rectification) 69/9, Carr. 15/-.

0-10-20-25 v. 24 a. (Gov. rating) 79/6. Carr. 15/-.

EXTENSION SPEAKERS

Limited number in handsome Walnut veneered cabinets. 2-3 ohm speech coils. 6½in. 29/9, 8in. 35/9.

MANUFACTURERS' SURPLUS TRANSFORMERS. Primary 230-250 v. Universal mtg. 350-0-350 v. 100 mA. 6.3 v. 4 a. C.T. 0-4-5 v. 3 a. 18/9. Post 2/9.

EX GOVT. SMOOTHING CHOKES

250 mA., 20 H., 150 ohms	19/6
200 mA., 3-5 H., 50 ohms. Parmeko	9/9
150 mA., 10 H., 50 ohms	10/11
150 mA. 6-10 H., 150 ohms, trop.	6/9
120 mA., 12 H., 100 ohms	9/9
100 mA., 10 H., 100 ohms	6/9
100 mA., 5 H., 100 ohms, tropicalised	3/11
80 mA., 20 H., 900 ohms	6/9
60 mA., 5-10 H., 250 ohms	2/11

EX GOVT. CASES. Well ventilated, black crackle finished, undrilled cover. Size 14×10×8½in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE, COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post. SPECIAL OFFERS. Small 2 gangs .0005 mfd., 4/9. Electrolytic Cans. 150 mfd. 450 v 3/9 ea. Lots of six 19/6.

BRAND NEW LUCAS MOTOR-CYCLE BATTERIES. 6 v. 22 A.H. (In sealed cartons.) Limited number available at only 29/9 each. Carr. 3/6. Normal price 71/- each.

14 WATT HI-FIDELITY AMPLIFIERS. For any type of pick-up and Mike. Store soiled but tested and guaranteed in perfect order. For 200-250 v A.C. Mains. Complete with 5 latest type valves. Only 6gns. carr. 7/6.

MIDLAND INSTRUMENT CO.

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CHASSIS. U.S. manufacture all aluminium, 15½ × 8 × 5½in. complete with top cover, some items have been removed, remaining are:—28 Amphenol midget ceramic B7G type v/holders, complete with cans, over 70 colour coded 5% resistors, also many ceramicons and other comps., trimmers, ,adders, fixed and variable inductances, transformer, v/control, etc., new, unused, bargain, 10/-, post 3/6.

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RELAYS, all new unused. U.S. type, 7600-ohms, single pole make, size 2½ × 2 × 1¼in., 3/6, post 9d., ditto, 60-ohms, 3-pole 3-make, size 1½ × 1½ × 1in., 2/6, post 9d. Siemens H.S. relays, 145-ohms, single-pole changeover platinum contacts, in metal cases with terminal block, 5/-, post 1/6, SC/649 relays, 26-ohms, 9-14 v., single make, 40-amp. D.C. contacts, in Bakelite cases, 2½ × 2½ × 1¼in., 2/6, post 1/-.

SIGHTING TELESCOPES by Ross, Taylor, Hobson, etc., these high quality instruments contain four 40 mm. dia. achromats, 2 of 3in. focal length, 2 of 3½in. focal length, also an 18 mm. dia. image erector achromat, 4 screw fine adjustment cross graticule, length 16in., weight 7lb., new and boxed, 25/-, post 3/3.

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SELENIUM RECTIFIERS. These are latest brand new G.E.C. supply, not ex-Govt., or assembled from bits, full-wave bridge 12-v. 1½ amp. cont., 3 amp. int., 10/-, post 1/-, ditto, 12-v. 3 amp. cont., 4 amp. int., 15/-, post 1/6; mains transformers to suit 200/230/250-v., with 5-11-17 v. outputs to charge 2, 6 or 12 v. battery, brand new, 1½ amp. type, 15/-, post 1/9; 3 amp. type, 20/-, post 2/3, complete with wiring diagram.

MOTOR GENERATORS, 4½in. long, 2½in. dia., weight 3lb., totally enclosed, black crackle finish, input 27 v., 1.5 amps., output 285 v., 60 m/A. from 12 v. output is approx. 150 v. at 40 m/A., ideal for operating electric razors from 12 v. car battery, new, unused, 12/6, post 2/-.

GRAMOPHONE MOTORS, dual voltage 100/130 v., 200/250 v. A.C. mains, size 9½ × 2 × 1¼in., weight 14 oz., ½in. long, ⅜in. dia. shaft, speed 1,350 r.p.m., rubber bushed mounting bracket, a superior motor of recent manufacture, brand new, boxed, 15/-, post 1/6.

Many other Bargains; send stamped addressed envelope for lists.

MIDLAND INSTRUMENT CO., MOORPOOL CIRCLE, BIRMINGHAM, 17

Tel.: HAR 1308

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FULL FREQUENCY STEREOPHONIC SOUND

A NEW AND VERY EXCITING EXPERIENCE IN LISTENING WHICH HAS COME TO STAY.

SPECIAL BARGAIN OFFER!

One pair of matched Deccamatic III amplifiers, made by the famous Decca Co., known to all music lovers throughout the world. Very sturdily built, finest possible components, tapped mains transformer, metal rectifier, Mullard ECL82 sound amplifier and output valve and twin spring loaded white knobs. Measurements: 8½in. x 3in. x 3in., complete with one pair of matched Celestion speakers (elliptical) of the very latest design. Supplied complete with all leads, ready to connect to your Stereophonic pick-up. Full operating instructions enclosed with each Unit.

COMPLETE £10/10/- only. P. & P. free.

Send S.A.E. for our very latest list of Radio, Television and Electrical components and equipment.

J. E. SEXTON LTD.

162, Grays Inn Road, London, W.C.1. *Tel. TERminus 0228-9*

TRANSFORMERS FOR MULLARD 510 AND STEREOPHONIC AMPLIFIER

ALL TRANSFORMERS. Fully guaranteed. Shrouded. Upright mounting, interleaved and impregnated. Primaries on all mains Trans. 240—220—200 : 0—10 v. 50 c/s.

T.101. For two 510 amps, low loading (6,000 ohm output trans.) 200-0-200 v., 120 mA., 6.3 v. 6 a. CT., 6.3 v. 1 a., 24/-. P. & P. 2/9.

T.35. For 510 Amp and Tuner, 300—0—300v., 120 mA. 6.3v. 2.5a.CT. 6.3v. 2.5a., 6.3v. 1a. 30/-. P./P. 2/6.

T.36. For 510 amp. 300—0—300v. 100mA., 6.3v. 2.5a.CT., 6.3v 1a., 27/-. P./P. 2/6.

T.44. "510" Ultra Linear Output Trans. 6000 ohm. 43% tappings. 30/-, P./P. 2/-.

T.100. "510" Low Loading Output Trans. 6000 ohm. (not Ultra Linear). 22/-. P./P. 2/-.

SPECIAL OFFERS. T.44 and T.35. 50/-, P./P 2/6.

ONE T.101 and TWO T.100's for Stereo Amplifier, 60/-, P./P. 3/6.

"POWER-PAKS"

Two new high efficiency mains transformers and contact cooled metal full-wave bridge rectifiers. 270 volts D.C 60-100mA. 6.3v 2-3 amps CT. write for full details.

SOUTHERN TECHNICAL SUPPLIES, 63 Station Road, Portslade, Sussex

AMPLIFIERS PRE-AMPLIFIERS

COMPLETE KITS OF PARTS FOR THE "HI-FI" ENTHUSIAST

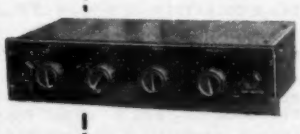
Designed by MULLARD—Presented by US strictly to their specification

MULLARD DESIGNS FOR THE HOME CONSTRUCTOR

THE VERY POPULAR MULLARD "5-10" MAIN AMPLIFIER

Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-Amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "Hi-Fi" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S SPECIFICATION with specified valves and components and including the latest PARMEKO Ultra-linear Output transformer and the Parmeko mains transformer which has power available to drive Radio Tuning Unit.
Price for COMPLETE KIT OF PARTS..... **£10.0.0**
Alternatively we supply ASSEMBLED and TESTED..... **£11.10.0**
(Carriage and insurance 5/- extra.)
We also offer this "5-10" incorporating the latest **PARTRIDGE ULTRA-LINEAR OUTPUT TRANSFORMER** for **£1/6/-** extra.

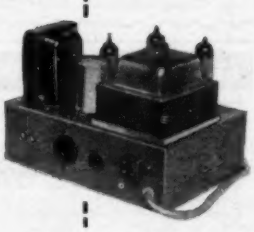
MULLARD'S NEW 2-STAGE PRE-AMPLIFIER TONE CONTROL UNIT



A completely new design employing two EF86 valves, and in particular designed to operate with the Mullard range of Power Amplifiers, but also perfectly suitable for other makes.
Briefly it incorporates—
- Equalization for the latest R.I.A.A. characteristics.
- Input for variable reluctance. Magnetic Pick-ups.
- Input for Crystal Pick-ups.
- Input for Tape replay.
  - (a) Direct from High Impedance Tape Head.
  - (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel.
- Wide range BASS and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION. **£8.6.0**

Price. COMPLETE KIT OF PARTS.....
Alternatively we supply ASSEMBLED and TESTED..... **£8.0.0**
(Carriage and Insurance 5/- extra.)

THE NEW MULLARD "3-3" MAIN AMPLIFIER



Based entirely on the present very popular "3-3" model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown here) thus providing all the facilities associated with the more extensive "Hi-Fi" equipment. We recommend it as the IDEAL SMALL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts).
We supply completely to MULLARD'S SPECIFICATION INCLUDING the latest PARMEKO Output Transformer specified Valves and Components. Has Power available to drive a Radio Tuning Unit.
Price for COMPLETE KIT of PARTS..... **£7.0.0**
Alternatively we supply ASSEMBLED and TESTED..... **£8.0.0**
(Carriage and Insurance 5/- extra.)

Special Price Reductions WE OFFER

Only NEW HIGH GRADE Components and Mullard Valves are supplied with these kits—we DO NOT use "Surplus or Cheap" components.

(a) THE COMPLETE KIT of PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-stage PRE-AMPLIFIER-CONTROL UNIT **£12.10.0**

(b) THE COMPLETE KIT of PARTS to build both the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£15.15.0**

*ALL PRICES QUOTED FOR THE "5-10" ARE SUBJECT TO £1/6/- EXTRA IF THE PARTRIDGE TRANSF. IS REQUIRED.

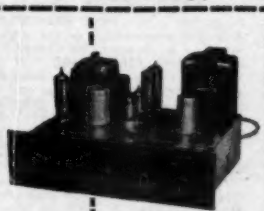
Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required . . . alternatively the COMPLETE ASSEMBLY MANUALS containing component Price Lists and practical Drawings etc. are available at 1/6 each.

(a) THE "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED..... **£15.0.0**
H.P. TERMS: DEP **£3** and 12 monthly payments of £1/2/- or DEP. **£5** and 12 monthly payments of 18/4.

(b) THE "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED..... **£18.18.0**
H.P. TERMS: DEP. **£3/10/-** and 12 monthly payments of £1/7/8 or DEP. **£6/6/-** and 12 monthly payments of **£1/9/1.**

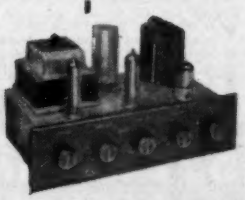
When ordering please include an extra 7/6 to cover the cost of carriage and insurance

THE NEW COMPLETE MULLARD "5-10" AMPLIFIER



We offer this popular and very successful design COMPLETE to MULLARD'S SPECIFICATION, but incorporating some improvements in the general layout. HIGH QUALITY REPRODUCTION up to a maximum of 10 watts output. The CONTROL UNIT is separate and completely enclosed; it is normally fitted to the Main Amplifier Chassis as shown in the illustration, but, if it is desired to use the unit remote from the Main Chassis, it can be quite easily detached and used up to 2 yards distance. We incorporate SPECIFIED COMPONENTS and NEW MULLARD VALVES. We also give the purchaser the choice of two of the best ULTRA-LINEAR OUTPUT TRANSFORMERS made—first the latest by PARMEKO LTD., and also the latest by PARTRIDGE (**£1/6/-** extra) which is generally recognised as the best U/L Output Transformer made today and ensures maximum undistorted output and the widest frequency range. We also supply the PARMEKO MAINS TRANSFORMER, and this has extra power available to supply a Radio Tuning Unit amounting to 250 volts at 35 mA. and a separate heater winding giving 6.3 volts 2½ amps.
Price COMPLETE KIT OF PARTS (PARMEKO TRANSFORMER) **£11.10.0**
Alternatively we supply ASSEMBLED and TESTED..... **£13.10.0**
H.P. Terms: Dep. **£2/14/-** and 12 monthly payments of **19/10.**
or Dep. **£4/10/-** and 12 monthly payments of **16/8.**
Send S.A.E. for ILLUSTRATED LEAFLET or **1/6** for the COMPLETE ASSEMBLY MANUAL.

THE NEW COMPLETE MULLARD "3-3"



A VERY HIGH QUALITY 3 WATT AMPLIFIER PROVIDING EXCELLENT REPRODUCTION AND HAVING AN ATTRACTIVE ENGRAVED PERSPEX FRONT PANEL
Price for COMPLETE KIT OF PARTS (plus 6/6 carriage and insurance.) **£7.10.0**
Alternatively supplied ASSEMBLED and FULLY TESTED..... **£8.19.6**
(plus 6/6 carriage and insurance).
The complete specification is available for 1/6.
Developed from the very popular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to the Mullard specification including supply of specified components valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for TR and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

Please enclose S.A.E. with all enquiries

STERN RADIO LTD. 109 & 115 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

The Popular Stern's "fidelity" TAPE RECORDER for truly "HI-Fi" Recordings

PRICE INCORPORATING COLLARO MK IV DECK **£49.10.0**

HIRE PURCHASE TERMS: Deposit £9/10/- and 12 months at £3/12/7 or Deposit £16/10/- and 12 monthly payments of £3/0/6.

PRICE WITH TRUVOX DECK INCORPORATING REV COUNTER..... **£52.10.0**

HIRE PURCHASE TERMS: Deposit £10/10/- and 12 months at £3/17/- or Deposit £17/10/- and 12 monthly payments of £3/4/2.

(Plus £1/10/- carriage and insurance of which £1 is refunded on return of packing case.)

THEY INCORPORATE

- Choice of the latest COLLARO TRANSCRIPTOR DECK or the NEW TRUVOX M. IV DECK.
- The model HF/TR3 "Fidelity" AMPLIFIER.
- ROLA/CELESTION 10in. x 6in. P.M. Speaker.
- 1,200ft. reel EMI tape.
- ACOS Crystal Microphone.

BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THIS MODEL—TRULY "HI-FI" RECORDINGS ARE OBTAINABLE and it is comparable to much higher-priced Recorders.

Send S.A.E. for ILLUSTRATED LEAFLET.

THE MODEL HF/TR3 TAPE AMPLIFIER

Incorporating *3-SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.* **PRICE** for COMPLETE KIT OF PARTS..... **£12/15/-** FULLY ASSEMBLED AND TESTED..... **£16/10/-** **HIRE PURCHASE:** Deposit £3/6/6 and 12 months at £1/4/2 or Deposit £5/10/- and 12 monthly payments of £1/0/2. A very high quality amplifier based on the very successful Type "A" design completed in the MULLARD LABORATORIES. ONLY NEW HIGH-GRADE COMPONENTS are incorporated including MULLARD VALVES and a GILSON OUTPUT TRANSFORMER . . . other features are: Magic Eye Recording Hand Indicator—Effective Tone Control—Monitoring and Extension Speaker Sockets—has own Power Supply and can be used as independent Amplifier for direct reproduction of Gram Records or from Radio Tuner. Overall size 11 x 6 x 6in.—Collaro—Lane—Brenell or Motek Decks—please specify which.
Send S.A.E. for leaflet or 2/6 for the complete Assembly Manual.

HOME CONSTRUCTORS

WE MAKE SPECIAL PRICES FOR COMBINED ORDERS

(a) THE COLLARO MK. IV DECK (SEE NOTE) and the HF/TR3 AMPLIFIER (assembled and tested) . . . **CASH PRICE £36. HIRE PURCHASE:** Deposit £7/4/- and 12 months at £2/12/6 or Deposit £12 and 12 months of £2/4/-.

(b) Precisely as in (a) above but the HF/TR3 AMPLIFIER supplied as COMPLETE KIT OF PARTS . . . **CASH PRICE £32/10/-.**

(c) THE TRUVOX MK. IV DECK and the HF/TR3 AMPLIFIER supplied assembled and tested . . . **CASH PRICE £38/10/-. HIRE PURCHASE:** Deposit £7/10/- and 12 months at £2/16/10 or Deposit £12/16/8 and 12 months of £2/7/1.

(d) Precisely as in (c) above but the HF/TR3 AMPLIFIER supplied as COMPLETE KIT OF PARTS . . . **CASH PRICE £35.**

(e) TRUVOX MK. IV DECK (incorp. Precision Rev. Counter) and the HF/TR3 AMPLIFIER, assembled and tested . . . **CASH PRICE £41/10/-. HIRE PURCHASE:** Deposit £8/6/- and 12 months at £3/0/10 or Deposit £13/16/8 and 12 monthly payments of £2/10/9.

(f) Precisely as in (c) above but the HF/TR3 AMPLIFIER supplied as COMPLETE KIT OF PARTS . . . **CASH PRICE £38.**

(g) The PORTABLE CASE—ACOS CRYSTAL MICROPHONE—ROLA 10 x 6 SPEAKER and 1,200ft. reel PLASTIC TAPE . . . ALL FOR £9. **Carriage and Insurance on any above is 10/- extra.**

NOTE: Messrs. Collaro supply the Transcriptor with the Deck Switches unwired. We will complete this wiring at £1 charge or alternatively supply a wiring diagram with deck.

TERMS ARE NOT AVAILABLE WHEN KIT OF PARTS IS SUPPLIED

STERN'S TAPE PRE-AMPLIFIER & ERASE UNIT

Provides the "Link" between the HIGH-QUALITY AMPLIFIER AND TAPE DECK.
MODEL HF/TRI.P. A completely assembled Pre-Amplifier with own Power Supply. Can be supplied correctly matched for use with TRUVOX or COLLARO Decks, and incorporates Recording Level Indicator and Monitoring Facilities. **£11.10.0** (plus 5/- carr. and ins.)

IF YOU HAVE A HIGH-QUALITY AUDIO AMPLIFIER (such as our Mullard 5-10 and associate 2-valve Pre-Amplifier) and wish to add full TAPE facilities—ALL YOU NEED IS THE ABOVE HF/TRI.P. UNIT together with a TAPE DECK. **WE OFFER YOU . . .**
(a) THE HF/TRI.P. PRE-AMPLIFIER together with the COLLARO MK. IV TAPE DECK (see note) . . . **CASH PRICE £32/10/-. HIRE PURCHASE:** Deposit £6/10/- and 12 months at £2/7/8 or Deposit £10/16/8 and 12 monthly payments of £1/19/9.
(b) The HF/TRI.P. together with the TRUVOX MK. IV DECK (incorp. Precision Rev. Counter) . . . **CASH PRICE £38. HIRE PURCHASE:** Deposit £7/12/- and 12 months at £2/15/9 or Deposit £12/13/4 and 12 monthly payments of £2/6/6.
NOTE: Messrs. Collaro when supplying the MK. IV Deck do not wire up the Deck Switches . . . we will do this at a charge of £1 or supply a wiring diagram to the home constructor.

THE NEW MULLARD TYPE "C"

TAPE PREAMPLIFIER-ERASE UNIT

A further development on the already successful and very popular "C" model. It incorporates THREE-SPEED TREBLE EQUALISATION by means of the FEROXCUBE POT CORE INDUCTOR together with an improved Oscillator Circuit. **THE ASSEMBLED UNIT** will be available approximately mid December and the **COMPLETE KIT OF PARTS** approximately mid January. **PRICES YET TO BE FIXED. PLEASE ENCLOSE S.A.E. WITH ANY ENQUIRY.**

TAPE EQUIPMENT IN STOCK

- COLLARO MK. IV TRANSCRIPTOR DECK . . . £24. **HIRE PURCHASE:** Deposit £4/16/- and 12 months at £1/15/2 or Deposit £8 and 12 monthly payments of £1/9/4.
- TRUVOX MK. IV DECK (incorporating Precision Rev. Counter) £30/9/-. **HIRE PURCHASE:** Deposit £6/2/- and 12 months at £2/4/8 or Deposit £10/3/4 and 12 monthly payments of £1/17/2.
- PORTABLE CARRYING CASE (as illustrated) accommodates HF/TR3 Amplifier and available for Truvox or Collaro Decks. £3.
- High Output ACOS CRYSTAL MICROPHONE £1/15/-.
- 10 x 6in. P.M. LOUDSPEAKER £1/10/-.
- 7 x 4in. P.M. LOUDSPEAKER 16/9 and 19/6.
- 1,200ft. reels E.M.I. or SCOTCHBOY TAPE £1/15/-.

We have a special line good quality Plastic Tape, 1,200ft. reels at 21/-.

STERN RADIO LTD.
109 & 115 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

STERN'S FOR STEREO

OUR POPULAR MULLARD MAIN AMPLIFIERS ARE RECOMMENDED FOR USE WITH THE DULCI DUAL CHANNEL STEREO PREAMPLIFIERS

The "STEREO EIGHT" PREAMPLIFIER
Price **£23.2.0**
(Carr. & Ins. 5/- extra)

The "STEREO TWO" PREAMPLIFIER
Price **£9.9.0**
(Carr. & Ins. 5/- extra)

Both Preamplifiers can be supplied to correctly operate with our very popular **MULLARD "5-3"** and **"5-10" MAIN AMPLIFIERS** (described on page 135). For Stereo reproduction TWO Main Amplifiers are necessary but for normal "Hi-Fi" reproduction the "Stereo Eight" and the "Stereo Two" are perfectly suitable to operate with ONE main Amplifier and the second main Amplifier can then be added at any time thus transforming a standard "Hi-Fi" installation over to the Stereo.

FULLY DESCRIPTIVE LEAFLETS ARE AVAILABLE. ENCLOSE S.A.E.

WE OFFER . . . ASSEMBLED and TESTED

(a) The "Stereo Two" with one "5-3" **MULLARD MAIN AMPLIFIER**.. **£17. 0.0**

(b) The "Stereo Two" with two "5-3" **MULLARD MAIN AMPLIFIERS**.. **£24. 10.0**
(This provides Stereo reproduction of max. 6 watts output and is an ideal Home Installation.)

(c) The "Stereo Two" with one "5-10" **MULLARD MAIN AMPLIFIER** **£20. 10.0**

(d) The "Stereo Two" with two "5-10" **MULLARD MAIN AMPLIFIERS** **£31. 10.0**

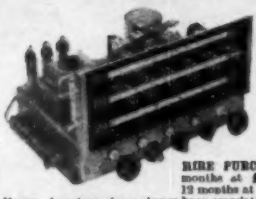
(e) The "Stereo Eight" with two "5-10" **MULLARD MAIN AMPLIFIERS** **£44. 10.0**
(This provides for up to 20 watts Output.)

(f) The above (a) with one **MULLARD "5-10"** **£34. 0.0**

OTHER STEREO EQUIPMENT AVAILABLE.
GRAM UNITS fitted with Stereo Cartridge by **GARRARD, COLLARO, LENCO, B.S.R.**
(These include Autochangers, Single Record Players and Transcription Units.)
STEREO CARTRIDGES and PICK-UPS by B.J., GARRARD, COLLARO, LENCO, B.S.R.
(Please enclose S.A.E. with any enquiry.)
DULCI TWIN POWER AMPLIFIER S.P.44 ..... **£12 . 12 . 0**

HIRE PURCHASE REDUCED TERMS ARE AVAILABLE.

! ! TO MODERNISE YOUR OLD RADIOGRAM ! !

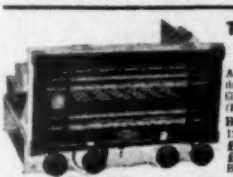


THE NEW ARMSTRONG "JUBILEE" AM/FM RADIOGRAM CHASSIS
PRICE **£30.9.0**
(Plus 7/6 carr. & ins.)

HIRE PURCHASE: Deposit **£6/2/-** and 12 months at **£2/4/8** or deposit **£10/8/4** and 12 months at **£1/17/8.**

Messrs. Armstrong have always been associated with very high class Equipment and this Chassis is undoubtedly one of the best they have ever produced.

MAIN FEATURES
- 6 watts push-pull output with negative feedback.
- 9 valves and 2 diodes.
- Full FM band (87-108 mc/s) plus Medium and Long waves.
- Automatic Frequency Control on F.M.
- Adjustable Ferrite Rod Aerial on A.M. Bands.
- Tape Playback and Record Facilities.
- Two Compensated Pick-up Inputs.
- Frequency Response 30-22,000 cps. +2 dB.
- Separate Wide-Range Bass and Treble Controls.
- Output Impedance for 3, 7½ and 15 ohms SPEAKERS.
- Tuning Indicator.
- Provision for Booster Unit for Low Output Pick-ups.
- A Satinised Brass Dial Escutcheon and Veneered Facia Board are available.
- Size of Chassis 12in. × 8in. × 7in. high.



THE DULCI MODEL H.4 AM/FM RADIOGRAM CHASSIS

A 4 Waveband Receiver Designed for first-rate reproduction of Radio and Gram.
(Plus 7/6 carr. & ins.) **£24.6.6**

H.P. TERMS: Deposit **£4/17/6** and 12 months at **£1/15/8** or deposit **£8/2/6** and 12 monthly payments of **£1/9/0.**

BRIEF SPECIFICATIONS:—
- Covers Short, Medium, Long and F.M. Wavebands.
- Employs Full A.V.C.
- For 3 or 15 ohm P.M. Speakers.
- The latest 7-valve line-up.
- "Magic Eye" Tuning Indicator
- Excellent Tone range up to 4 watts output.
- Internal Aerial for local stations.
- Overall size 12in. × 8½in. × 7½in. high.

SPECIAL CASH ONLY OFFER ! !

This very attractive **PORTABLE AMPLIFIER CASE** together with a good quality **GRAM AMPLIFIER** and a matched **P.M. SPEAKER.** ALL FOR ONLY **£8.7.6** (plus 7/6 carr. and ins.) The Amplifier consists of a 2 Stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-Stage (plus Rectifier) **AMPLIFIER** **£4 . 2 . 6**
(b) The **PORTABLE CARRYING CASE**.... **£3 17 6**
(c) 6½in. **P.M. SPEAKER** **18 9**
(Carriage and insurance 4/- extra.)

We also have a smaller **PORTABLE CASE Ideal for Record Players.** PRICE ONLY **£3/3/-** (plus carriage and ins.)

! ! HOME CONSTRUCTORS ! !

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS

Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. The acoustically designed **Bass Reflex** Cabinets containing the very successful "Stentorian" Speakers give really first class reproduction and are well recommended. Models are also available to accommodate high quality Amplifiers, Preamplifiers, Tuning Units, Record Players, etc. All models are very easily assembled, in fact only a Screwdriver is required.

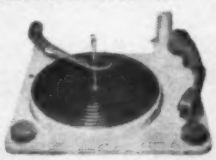
Fully illustrated leaflets are available including complete specifications of the various STENTORIAN LOUDSPEAKERS. Please enclose S.A.E.

! ! RECORD PLAYERS ! !

THE LATEST MODELS ARE IN STOCK MANY AT REDUCED PRICES ! ! !

Send S.A.E. for Illustrated Leaflet.

A FEW CASH BARGAINS



B.S.R. MONARCH UA8 4-speed mixer Autochanger with Crystal Pick-Up **£6.19.6**

The **COLLARO "CONQUEST"** 4-speed autochanger Studio Pick-up **£7.19.6**

The latest **COLLARO "CONTINENTAL"** 4-speed MIXER Autochanger, Studio "O" Pick-up **£8.15.0**

The **COLLARO** 4-speed Single Record Player, Studio Pick-up **£6.19.6**

THE NEW B.S.R. model UA12 is in Stock. A4 "SPEED" MIXER AUTOCHANGER. **£8.19.6**

UA12 also available incorporating the **B.S.R. STEREO Pick-up**, plays L.P. and 78 Records.. **£11.17.6**

B.S.R. Model TU9 4-speed single record player, complete with separate crystal pick-up..... **£4.10.0**

(This high output pick-up is available separately for **£1/19/6.**)

HIGH FIDELITY UNITS IN STOCK

The latest **GARRARD TRANSCRIPTION MOTOR "301"** with Stroboscopically marked turntable **£28.0.11**

The new **GARRARD Model 4HF** High Quality Single Record Player fitted with the latest **T.P.A.** 12 pick-up arm and **G.C.8** Crystal Cartridge **£19.7.10**

As above but fitted with the **G.M.C.5** Moving Coil Pick-up and **T.P.1** Transformer **£27.14.7**

GARRARD Model TA/MK II Single Record Player fitted with high output Crystal Pick-up detachable Head **£9.15.8**

The **GARRARD T.P.A. 12 TRANSCRIPTION PICK-UP ARM** is available separately or with Crystal or Moving Coil Pick-up Heads.

GARRARD AUTOCHANGERS AVAILABLE FROM STOCK INCLUDE MODELS:
RC. 121/4 Mk II RC.88/4 RC.90/4.
Carriage and insurance on each above 5/- extra.

STERN RADIO LIMITED

109 & 115 FLEET STREET, LONDON, E.C.4 FLEET ST 5812-3

CAR BATTERY CHARGER

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COMBINED AM/FM TUNING UNIT INCORPORATING OWN POWER SUPPLY

is in Stock. Specifically designed for operation with High Fidelity Amplifiers and capable of very high performance on Long, Medium and Short Wavebands plus the complete VHF/FM Transmissions. Thoroughly recommended where a complete self-covered "All Wave" Tuner is wanted.

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PRICE **£15.0.0**
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Incorporates the latest **MULLARD PERMEABILITY TUNING HEART** and the corresponding **MULLARD VALVE LINE UP** comprising ECC85, 2 type EF85's (or EF95's), EM84 Tuning Indicator, plus 2 type O.A. 70's Germanium Diodes. A really first class Tuner very attractively presented and comparable to many offered at much higher prices. Power consumption is only 1.5 amps. at 6.3 volts and 25 m/a. at 200 volts.

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YOU CAN BUILD THIS TUNING UNIT FOR ONLY **£11.0.0**
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Price Assembled and Tested **£13.10.0**

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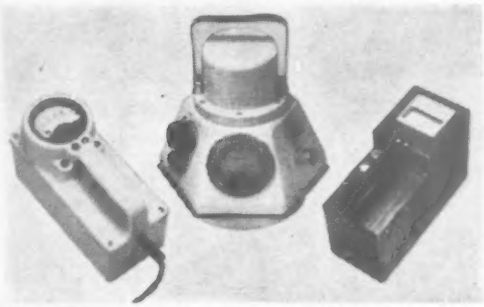
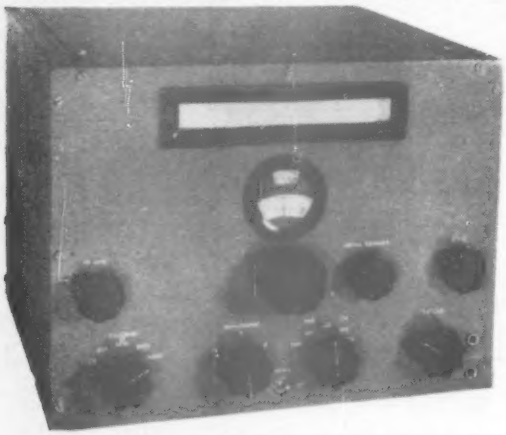
PHILIPS RADIATION MONITOR Type 1092C (*not illustrated*). A portable self-contained instrument for measuring radio-activity, uses the Mullard MX-115 Geiger counter tube, and is scaled 0-10 milliRöntgens per hour. Supplied complete with carrying haversack. BRAND NEW, boxed, **£17/10/-**. Carr. 5/-. COME AND INSPECT our large assortment of radiation monitoring equipment, dose-meters, etc. We are selling these at prices which enable experimenters to acquire unusual apparatus very cheaply



Centre. **GAMMA RADIATION MONITOR** by Ediswan. Contains 200 micro-amp. meter, VX805 electrometer valve, etc. ONLY **59/6**. Post 3/6.

Right. **EKCO PORTABLE DOSE-RATE METER** 1018A/B. Contains modern type rectangular 50 micro-amp. meter, CVX495 electrometer valve, etc. Range 0-3 Röntgens per hour. In canvas carrying case. BRAND NEW. **£6/19/6**. Post 3/6.



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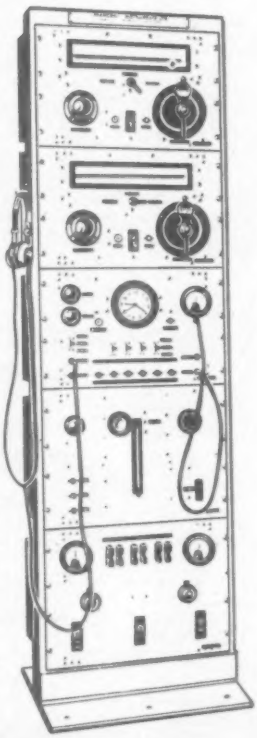

COMMUNICATIONS RECEIVER B28, (MARCONI CR100).

PRICE — ONLY £21.

Later Model with Noise Suppressor £25

Carriage England and Wales 30/-. *Send S.A.E. for further details.*

CR100 SPARES KITS.

Contents: 15 valves, 2 of U50, DH63, KT63, X66, and seven KTW61. Output transformer. Resistors, Condensers, Potentiometers, PK screws, pilot lamps, drive cord, etc., etc. ALL BRAND NEW. **59/6.** Post 4/6.

EXPORT OFFER. We have available a quantity of Petrol/Electric Generating Sets type PE-78-J & K. These are rated at 12.5 KVA, and the output is either 120 v. or 240 v. at 60 c/s, single phase. These are BRAND NEW ex-U.S.A. Government surplus, still in original export cases, complete with tools, running spares, and installation materials. Illustrated details will be sent to export houses, etc. upon request.

AVOMETER Model D. £6-19-6 (*P. & P. 4/-*)

D.C. Volts	A.C. Volts	D.C. Current	A.C. Current
150 mV.	7.5 V.	15 m/A.	75 m/A.
300 mV.	15 V.	30 m/A.	150 m/A.
1.5 V.	75 V.	150 m/A.	750 m/A.
3 V.	150 V.	300 m/A.	1.5 Amps.
15 V.	300 V.	1.5 Amps.	7.5 Amps.
30 V.	600 V.	3 Amps.	15 Amps.
150 V.	705 V.	15 Amps.	
300 V.	1.5 KV	30 Amps.	Resistance
750 V.			0-1,000 ohms.
1.5 KV.			0-10 K ohms.

Thoroughly overhauled. Complete with batteries and instructions. An extremely robust meter at a very reasonable price.

SANGAMO WESTON MODEL E772 ANALYSER £8-19-6 (*Carr. 4/6*)

A.C. and D.C. Volts	D.C. Current	A.C. Current
2.5 V.	100 micro-Amps.	0.5 Amps.
10 V.	1 milli-Amp.	1 Amp.
50 V.	10 milli-Amps.	5 Amps.
250 V.	50 milli-Amps.	**Resistance**
1,000 V.	100 milli-Amps.	0-100 ohms.
	500 milli-Amps.	0-1,000 ohms.
Output Meter		0-100 K ohms.
		0-10 Megohms.

Supplied in neat black Rexine covered carrying case, complete with all batteries and instructions. Thoroughly overhauled and in perfect working order.

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RMS. D.C. output 30 v. 10 amps. BRAND NEW. Boxed. 45/-. Post 3/6.

ADMIRALTY HT TRANSFORMERS Pri. 230 v. 50 c/s. Secs. 620-550-375-0-375-550-620 v. (620 and 550 v. 200 m/amps., 375 v. 250 m/amps.), plus two 5 v. 3 Amp. rectifier windings. Total rating 278 VA. Upright mtg. Wt. 25lb. Made 1953. **BRAND NEW.** Original boxes. 45/-. Carr. 5/-.

MAINS ISOLATING TRANSFORMERS (Vortexion). Fully-shrouded. For testing A.C./D.C. sets in safety. 230 v. input. Output 230 v. 100 watts. 22/6. Post 2/6.

DUAL PURPOSE TRANSFORMERS (Gresham). Pri 230/250 v. Secs. 240-0-240 v. 1.5 amps., 5 v. 12.5 amps. 5 v. 1.75 amps. Ideal for ISOLATING TRANSFORMER, to obtain TWO 240 v. 360 watt lines. Potted, oil-filled. 7" × 7½ × 10½in. high. Wt. 50lb. **BRAND NEW.** £3/10/-. Carr. 10/-.

INSTRUMENT TRANSFORMERS. 230 v. A.C. input. Outputs 0-65-130-195 v. 85 m/amps., 6.3 v. 5 amps., 6.3 v. 0.3 amps. Shrouded. Size 3½ × 3½ × 3½in. high. 15/- post FREE.

AR88D MAINS TRANSFORMERS. Input 110-240 v. Output 345-0-345 v. 125 m/amps., 6.4 v., 4.5 amps., 5 v. 2 amps. 4½ × 4½ × 5½in. high. Wt. 12lb. Potted. Tag ends. RCA BRAND NEW. Boxed. 29/6, post 3/6.

TRANSFORMER BARGAIN. Input 0-200/250 tapped. Outputs 250-0-250 v. 80 m/amps. 5 v. 2 amps.; 6.3 v. 4.5 amps. Upright mtg. BRAND NEW. Boxed Ex-Admiralty made 1952. A fine 50 c/s mains tranny for ONLY 16/6, post FREE.

HEAVY DUTY L.T. TRANSFORMERS. (Gresham.) Latest type potted, oil filled, Pri. 230 v. 50 c/s. Sec. 0-70-75-80 v. 4 amps. Size 5½ × 4½ × 6½in. high. Wt. 19lbs. BRAND NEW. 42/6, carr. 5/-.

MODULATION TRANSFORMERS. Collins type 20 watts 807 to 807 8/6 each Post 1/6.

FERRANTI TYPE, for Tx 36 etc., push-pull 807's to plate and screen modulate push-push 807's, ratio 2:1. Fully shrouded. Wt. 6½lbs. 17/6. Post 2/6

6-VOLT VIBRATOR PACKS. HRO type, 180 v. D.C., 65 m/amps. BRAND NEW. 29/6, post 3/6. Type PU2, 200 v. D.C. 100 m/amps., with OZ4 rectifier. **BRAND NEW.** 25/-. Post FREE.

CHOKES. Parmeko 5 H. 200 m/amps 6/6, post 1/6. HRO chokes 17H., 80 m/amps. 7/6, post 1/6

RESISTORS

Morgan "T" (½ watt) and "R" (1 watt). Latest types, all BRAND NEW. 100 assorted, 10/-, post 1/-.

CRYSTALS. 200 Kc/s. American GEC, 10/- each. 100 Kc/s. RCA bars, 15/-.

COLLINS TCS TRANSMITTERS

Covers 1.5-12 Mc/s. (25-200 metres) in 3 bands. Complete with 7 valves: 3 of 12A6 Osc.: 1625 Buffer; 2 of 1625 PA: 1625 Mod. VFO or crystal control, with 4 crystal positions. C/W or R/T. Meters for plate and aerial current. **BRAND NEW** internally and unused, but externally store soiled. **£7/19/6.** Carr. 15/-.

R.F. UNITS

RF24.	20-30 Mc/s. 5 switched positions	12/6
RF26.	50-65 Mc/s. Super slow-motion drive	17/6
RF27.	65-80 Mc/s. Super slow-motion drive	22/6

Unboxed, but as new condition. Post 3/6.

MORSE TRAINERS

Two independent valve oscillators (one with pitch control) for one or two operators to practice simultaneously. Has provision for creating "atmospherics." In polished oak case, 12½ × 10 × 8in. Wt. 16lbs. Complete with 2 valves, leads, 2 keys, 7-way phone terminal board circuit, and instructions, but less batteries and phones. **12/6.** Carr. 7/6. Phones, 7/6 pair

MONITOR TYPE 61

3½in C.R. Tube. A.C. mains power pack. Very modern design. Ideal for conversion to oscilloscope full data supplied. Condition as new. **£7/19/6.** Carr. 15/-.

AMERICAN METERS. Triplett 100 microamp., 4in. meters, scaled as multimeter, exactly as used in Combination Tester. BRAND NEW Boxed. 79/6. Post 1/6.

Trinsit 100 microamp. 3in. square, flush mtg. Scaled as output meter 0-15 and 0-6 volts A.C. Rectifier not fitted. BRAND NEW. Boxed. 42/6. Post 1/-. **Westinghouse** 0-5 Milliamp. D.C., flush mtg., circular 2in. blank back scale. BRAND NEW Boxed. 8/6. Post 1/-.

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Evershed & Vignoles "Wee" Meggers, 500 volts, complete in leather case, with leads. AS NEW. **£8/19/6.**

E. & V. Series 2 Meggers. 500 volts, 0-100 Megohms. In leather case. First-class condition. ONLY **£16.**

INSULATION TESTERS. "Record" hand generator type. 0-50 Megohms at 500 volts pressure. Complete in leather case. **£7/19/6.** Post 4/-.

MINIATURE 373 IF STRIPS. For FM tuner described in "Practical Wireless." Complete with 3 of EF91, 2 of EF92 and 1 of EB91. A fresh release enables us to offer these once again. BRAND NEW. Complete reprint of conversion instructions and circuit supplied free. **37/6.** OR less valves, 12/6. Post, either 2/6.

HRO SENIOR MODELS

Complete with valves, 9 general coverage plug-in coilsets 50 Kc/s to 30 Mc/s., instruction booklet, and circuit, but less external power supply unit. Table models, as new condition, **21 GNS.** Packing and carriage 22/- extra. *Send S.A.E. for further details.*

HRO POWER PACKS. 115/230 v. A.C. mains input. Tested, and in good condition **69/6**, post 4/-

METER BARGAINS

RANGE	TYPE	SIZE		PRICE
50 Microamp.	D.C. M/C	2½in.	Flush Circ., scaled 0-100	59/6
100 Microamp.	D.C. M/C	2½in.	Flush Circ.	42/6
100 Microamp.	D.C. M/C	2½in.	Flush Circ., scaled "Mega."	39/6
1 Milliamp.	D.C. M/C	2in.	Flush Square. Fe/NFe. 1954	22/6
1 Milliamp.	D.C. M/C	2½in.	Flush Circ. Made 1964	25/-
1 Milliamp.	D.C. M/C	3½in.	Flush Circ.	35/-
1 Milliamp.	D.C. M/C	6in.	Flush Circ. Scaled 0-12 v.	79/6
200 Milliamp.	D.C. M/C	2½in.	Flush Circular	10/6
1 Amp. Thermocouple		2½in.	Projecting Circular	6/9
1 Amp. Thermocouple		2½in.	Flush Circular	7/6
4 Amp. Thermocouple		2in.	Flush Square	6/9
15 Volts	A.C. M/I	2½in.	Flush Circular	8/6
300 Volts	A.C. M/I	6in.	Flush Circular. Made 1964	79/6
300 Volts	A.C. M/I	2½in.	Flush Circular	25/-
500 Volts	A.C. M/I	2½in.	Flush Circular	25/-
60 Amperes	D.C. M/C	3½in.	Flush Circular	7/6

METAL RECTIFIERS. Full wave bridge. BRAND NEW. Salford 1 mA., 8/6. 5 mA., 8/6. STC 2 mA., 5/6.

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HICKOCK 1-177 VALVE TESTERS. Checks dynamic mutual conductance, shorts, emission, gas, and noise. For UX4, UX5, UX6, UX7, Octal, Loctal B7G, and Acorn types. Portable in wooden carrying case 15½ × 8 × 5½in. Wt. 13½lb. BRAND NEW. Complete with instruction book and valve testing charts. For 117 v. A.C. 10 gns. Carr. 7/6. Matching auto. transformer for 230 v. A.C., 12/6.

CRYSTAL CALIBRATORS. Gives 1 Mc/s., 100 Kc/s. and 10 Kc/s. "pips" with or without modulation. Employs dual 1,000/100 Kc/s. crystal and multivibrator circuit, and three 12SC7 valves. Made by Canadian Marconi Co., originally for use with the Wireless Set No. 19. Operates from 12 v. 0.45 amps. L.T. and 250 v. D.C. H.T. In neat metal case 2 × 4½ × 9½in. deep. BRAND NEW. In original packing, complete with two spare valves, instruction book, connectors, etc. **£4/19/6.**

MULLARD C. & R. BRIDGES. 0.1 ohm. to 10 Megohms in 4 ranges; 10 pFd. to 10 mFd. in 3 ranges; Calibrate. Open Bridge, and % range. For 100-250 v. A.C. mains. Tested and guaranteed. **£7/10/-.** Post 3/6.

HEAVY DUTY SLIDER RESISTORS. 3 ohm. 10 amp., 12/6; 1.25 ohm. 20 amp., 12/6; 0.4 ohm., 25 amp. 10/-. Post, any type, 3/6. 1 ohm. 12 amp., 8/6. Post 2/-.

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MOVING COIL PHONES. Finest quality Canadian, with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. 19/6. Post 2/6.

INVICTA LOUDSPEAKERS. Good quality 10in unit (impedance 3 ohms.). In wooden cabinet 17 × 17 × 6in. Complete with 50ft. lead and jack plug. BRAND NEW. 39/6. Carr. 5/6.

BENDIX MODULATOR/POWER UNITS. Type MP-28-BA. for TA-12 transmitters. With 24 v. D.C. input, 540 v. D.C. 450 m/a. output dynamotor, 6N7met Mic. Amp., 6F6met Driver, and two 807 PP Modulators. Complete with Mic. Transf. and Mod. Transf. for modulating two parallel 807's. BRAND NEW 79/6. Slightly soiled 69/6. Carr. 7/6.

DYNAMOTORS. As used in the above. BRAND NEW. 32/6. Used 19/6. Wt. 13lb. Carr. 4/-.
Input 12 v. D.C. output 230 v. D.C. at 100 m/amps. American. 5½ × 3½in. diam. Wt. 5lb. 32/6. Post FREE.

DC/AC ROTARY CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0-300 v. A.C. 2½in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. **£9/19/6.** Carr. 10/6.

R1155 RECEIVERS. With latest type super slow motion drive. In good condition and perfect working order, re-aligned and air tested. Model "B" **£7/19/6.** Model "L" (covers trawler and shipping bands) **£12/19/6.** Carr. (either) 10/6. Send S.A.E. for details of sets and power units, or 1/3 for illustrated booklet.

MARCONI LOOP AERIAL type 696. A small, compact, enclosed loop. On swivel mount with degree scale. BRAND NEW. 69/6. Post 2/6. Ideal for R1155, etc.

SIEMENS HS RELAYS. Single change-over, 1000+1000 ohms coil. Brand new 10/6.

MARCONI TF-340 OUTPUT METERS. Perfect working order. **£29/10/-.**

SANGAMO-WESTON VOLTMETERS 2½in. Dual range 0-5 and 0-100 v. D.C. FSD 1 m/a. 3in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads. BRAND NEW. Boxed. 27/6. Post 2/6

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DULCI H4T2, AM/FM, self-powered	£24 19 0
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DULCI, FM, self-powered	£17 10 0
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EMPRESS 5S8 STEREO GRAM CHASSIS	£28 7 0

CHASSIS, AM/FM

ARMSTRONG "JUBILEE" 9 valves, push-pull, AFC	£30 9 0
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STEREO SPECIALS S.T.1 STEREO AMP.
A wonderful new stereo amplifier of very small size and moderate price specially suited to portable equipment. Employs 2-ECL82, EZ80. Negative feed-back, ganged Tone and Volume controls. Separate balance control. Size only 7 × 5 × 2¼in. Will fit New Style Portable Cabinet. Only £6, plus 3/6 P. & P. Further details on request.

S.T.2. PRINTED CIRCUIT STEREO AMPLIFIER. A beautifully made printed circuit stereo amplifier ideal for portable equipment of superior quality. Valve line-up: 2-6AQ5, 2-12AX7 and 1-EZ81. Ganged volume, Bass and Treble Controls. Supplied complete with two good-quality 5in. loudspeaker units, but less mains transformer. All connections clearly marked. Size 4½ × 10½ × 3½in. high. ONLY 11 GNS. plus 3/6 P. & P. Note: Special mains transformer can be supplied for above at 16/6. Power requirements: 250-0-250 v. at 60 ma. 6.3 v. at 1.5 amps.

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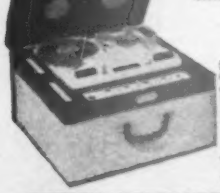

Comprising:

Collaro Mark IV Tape Transcriptor Deck	£25 0
Special ready built amplifier	£14 14
8 × 6in. elliptical loudspeaker	£1 10
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OUR SPECIAL INCLUSIVE PRICE ONLY 39 GNS. If all items purchased together, plus 15/- C. & P. Full assembly instructions provided. Note: We shall be pleased to wire the tape deck switches for you if you wish, at an extra charge of £1. Hear this wonderful recorder at either of our branches or send stamp for further details. Terms available.

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We stock all leading makes including B.T.H., Wharfedale, W.B., Goodmans, etc., etc. Enquiries invited.

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COLLARO AC 3/554. Three-speeds single record Player for AC mains, 200/250 v. Cream finish, complete with turnover crystal pick-up incorporating the well-known high output "T" type head. Strictly limited quantity at £5/19/6 plus 3/6. P. & P.

LATEST B.S.R. UA12. Stereo 4-speed auto-changer unit complete with FUL-FI stereo cartridge for monaural or stereo records. Brand new and fully guaranteed. £12/12/- plus 3/6 P. & P.

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THE LATEST COLLARO "CONQUEST" 4-speed autochanger in cream with Studio "O" insert. £7/19/6, plus P. & P. 3/6.

GARRARD RC. 121D MK. II STEREO MONAURAL 4-SPEED AUTO-CHANGER

This is the very latest unit by this famous manufacturer. Supplied complete with GC8 plug-in turnover crystal head and sapphire styli for 78 and L.P. standard records. Brand new and fully guaranteed. Very limited stocks at ONLY £11/0/6, plus 5/- P. & P. NOTE: The very latest Garrard L.P. Stereo plug-in head for above unit can be supplied as an optional extra for only £2/0/1 inc. P.T. Terms available

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A quality 4-speed single-record unit complete with TPA12 transcription arm and GC8 crystal pick-up. Size (space read.) 17¼ × 13½ × 3¼in. above board and 3¼in. below. PRICE £19/7/10. Plus 3/6 P. & P.

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AN ELECTRONIC ORGAN

Many readers will be interested to hear that we are in the process of constructing the excellent Electronic Organ designed by Mr. Alan Douglas, M.I.R.E., A.M.I.E.E. The completed organ will be on view at our Holloway Road branch in due course (see later for announcement). For the benefit of all would-be constructors, all Components, Keyboards, Chokes, etc., will be available ready made. Your enquiries are invited. Full constructional details available in book form at 15/- plus 1/6 P. & P.

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GARRARD 301	£26 8 3
GOLDRING-LENCO 58	£23 7 10
COLLARO 4TRSS	£10 18 0

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SOUND 333	£27 6 0
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SOUND 777, less mike	£46 5 0
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GRUNDIG TK.20, with mike	£52 10 0
GRUNDIG TK.30, with mike	£75 12 0
TRUVOX R.1, with mike	£72 9 0
TRUVOX R.2	£99 6 0
TANBERG STEREO RECORDER	£119 14 0

TAPE DECKS

COLLARO MK. IV TAPE TRANSCRIPTOR	£25 0 0
COLLARO MK. IV TAPE TRANSCRIPTOR, wired for use with Pre-Amplifier	£26 10 0
TRUVOX MK. III	£24 3 0
TRUVOX MK. IV, with digital counter	£30 9 0
HARTING/DULCI, with pre-amplifier	£57 15 0

TAPE AMPLIFIERS

COLLARO PRE-AMPLIFIER, for use with TAPE TRANSCRIPTOR	£21 0 0
TRUVOX TYPE "C" AMPLIFIER	£17 17 0
LINEAR LT45 AMPLIFIER	£12 12 0
JASON JSM/1 TAPE UNIT	£37 0 0

CABINETS

To suit all types of equipment. Prices from 45/-. Send stamp for list.

RECORD HOUSING "NORDYK" UNITS

WE NOW STOCK THE FULL RANGE OF "RECORD HOUSING" CABINETS. These cabinets are renowned for their excellent quality and superb finish. Send for illustrated leaflet of complete range.

EXTRA SPECIAL OFFER!!

A small three-valve PORTABLE RECORD-PLAYER AMPLIFIER mounted on baffle 12 × 7in. with High Flux 6½in. Loudspeaker. Valve line-up ECC83, EL84, EF80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high resistance pick-up. Ready to use. £5/12/6 Plus 3/6 P. & P.

NEW STYLE CABINET finished in two-tone Fawn and Brown Leatherette. Will accommodate above Amplifier and Baffle without modification, also most types of Ancillary Equipment. Overall size: 18 × 13½ × 8½in. Fitted with carrying handle. £3/9/6 plus 5/- P. & P.

NOTE. If both items purchased together they will be supplied at a special inclusive price of £8/7/6 plus 6/6 P. & P.

Our advantageous deferred terms are available on any single item over £5. Your enquiries invited.

If not stated, please add postage on orders under £1. Cash with order or C.O.D. (charges extra).

Open: Tottenham Court Road. 9 a.m. to 6 p.m. Mon. to Fri., Sat. 1 p.m. Holloway Road: 9 a.m. to 6 p.m. daily. Thurs. 1 p.m., Sat. 5.30 p.m.

PORTABLE GRAM AMPLIFIERS

RCL.A AMPLIFIER. A small high-quality gramophone amplifier employing the latest circuitry and highly efficient miniature valves. Very neat chassis finished in bronze stove enamel. Size (overall) 5¼ × 4 × 3in. Valves, 6X5, ECL82. Output 3 watts max. Controls, Volume, Tone/On/Off. For use on AC mains 200/250 v. Price **£3/19/6** plus 2/-. P. & P.

RC2A. Small PRINTED CIRCUIT single-valve high-gain amplifier for the smaller type of portable. Employs latest type ECL82 valve. Further details on request. Price only **59/6** plus 2/-. P. & P.

RC3A. A superior quality 3-valve amplifier employing EZ80, EL84 and ECC83. With separate bass and treble controls. Further details on request. Price **£3/10/6** plus 2/6. P. & P.

DECCA PORTABLE AMPLIFIER. As supplied in famous **DECCAMATIC III.** Complete with small cream control panel escutcheon and knobs. Full range tone and volume controls. Employs ECL82 valve. Size 2 × 3½ × 8½in. Only 59/6 plus 2/6 p. & p.

SPECIAL CELESTION 8 × 6in., elliptical high flux loudspeaker 30/- plus 1/- P. & P.

VERY ATTRACTIVE PORTABLE CABINET in Red and White polka dot for accommodating the above items and ancillary equipment, 75/-, plus 4/- P. & P.

NOTE. Supplied post free if all above items purchased together.

MULLARD 5-3 HI-FI AMPLIFIER to Mullard spec. Assembled, tested, fully guaranteed.
£8/8/- plus 3/6 P. & P. Leaflet on request.

M.G.P. 56 CRYSTAL INSERT. Complete with LP and RTD Sapphire Stylt. Brand new. 18/- plus 9d. P. & P. Suitable for B.S.R. Monarch, etc.

N.B.—All our T.R.F. circuits include specially wound Denco "Max Q" coils on polystyrene formers. Denco Rich "Q" coils are supplied for our "RAMBLER" Superhet Portable.

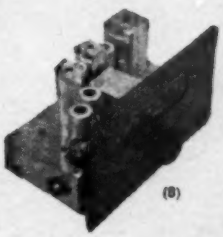
TO BUILD YOURSELF

• ALL PARTS AVAILABLE SEPARATELY •

WE ARE THE EXPERTS IN THIS FIELD AND CARRY THE MOST COMPREHENSIVE STOCKS IN THE COUNTRY

	All required components at special inclusive price	Instruction Book and P. itemised & price list P. available separately
(1) New Look "RAMBLER" all dry s'het portable ...	£7 7 0	2/6 1/6
(2) "RAMBLER" Mains Unit (suitable for most portables) ...	£2 7 6	1/6 9d.
(3) "ECONOMY FOUR" T.R.F. Mains Receiver ...	£5 10 0	2/6 1/6
(4) "FAMILY FOUR" (our new T.R.F. Receiver) ...	£4 19 6	2/6 1/6
(5) "SUPERIOR FOUR" (four valve mains receiver)	£6 9 6	2/6 1/6
(6) GRAM Chassis 5-valve Superhet ...	Now Discontinued	
(7) T.S.L. F.M. Tuner (self powered) ...	£10 19 6	3/6 2/6
(8) Standard JASON F.M. Tuner ...	£6 15 0	2/6 2/-
(9) Fringe area JASON F.M. Tuner ...	£7 15 0	2/6 2/-
(10) JASON "MERCURY" Switch tuned F.M. feeder	£9 19 6	2/6 2/-
(11) OSRAM 912 Printed circuit F.M. Tuner ...	£8 8 0	2/6 2/6
(12) JASON "ARGONAUT" AM/FM Chassis ...	£15 5 0	2/6 2/-
(13) JASON "ARGONAUT" AM/FM Tuner ...	£13 19 4	3/6 2/-
(14) F.M. Power pack (suitable for most tuners) ...	£1 17 6	1/6 1/-
(15) R.C. 3/4 watt amplifier (with Bass, Middle and Treble controls) ...	£4 5 0	2/6 1/-
(16) 2-amp. Battery Charger ...	£1 16 6	2/6 3d.
(17) R.C. Transistor/Crystal Receiver (with 'phones) ...	£1 17 6	1/3 3d
(18) R.E.P. 1-valve Battery Receiver ...	£2 2 0	2/- 9d.
(19) "CRY-BABY" ALARM (Baby Alarm) ...	£3 12 6	2/6 1/-
(20) "R.E.P. MINI-7" Transistor Portable (see opp.)...	£9 19 6	2/6 1/6
(21) MULLARD 510 Amplifier (printed circuit) Ultra Linear version ...	£9 9 0	3/6 3/6
(22) TELETRON "COMPANION" 3-Transistor Printed Circuit Portable ...	£4 19 6	2/- 6d.
(23) TELETRON "TRANSIDYNE" Transistor Portable	£11 19 6	2/6 1/-
(24) "DE-LUXE" Printed Circuit Superhet ...	£7 19 6	3/6 1/6
(25) JASON J.T.V. Tuner ...	£13 19 6	3/6 3/6
(26) RADIO JACK ...	19 6	1/6 6d.
(27) MULLARD TYPE "C" Tape pre-amp ...	£12 9 6	3/6 2/6
(28) TAPE RECORDER (with Collaro Mk. IV deck) ...	£40 19 0	15/- 1/-
(29) JASON J. 3-3 Stereo pre-amp. ...	£15 17 0	2/6 2/6
(30) JASON J 4-4 Stereo pre-amp. ...	£22 14 0	2/6 3/-

(23)



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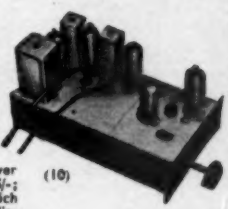
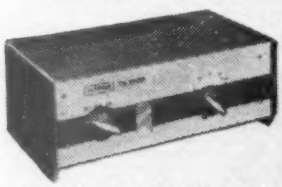


(10)

The following are also available assembled and tested:—(2) "RAMBLER" Mains Unit, **£3/5/-**; (7) T.S.L. F.M. Tuner, **£13/15/-**; (14) F.M. Power Pack, **52/6**; (15) R.C. 3/4 watt Amplifier, **£5/5/-**; (16) 2-amp. Battery charger, **45/-**; (19) "CRY-BABY" Alarm, **89/6**; (21) Mullard 510, **£12/12/-**; Instruction Books which contain full description, easy-to-follow practical wiring diagrams, theoretical diagrams, itemised price lists, etc., are supplied free of charge with all parcels but may be purchased separately if required.

NOTE: (2) The "RAMBLER" Mains Unit is suitable for use with MOST all-dry portables.

JASON J.T.V. TUNER



(As described in September issue Hi-Fi News)

All components for building this long awaited tuner, covering **3-BBC FM** and **BBC/ITV** sound channels, can be supplied ex stock, at a special price of **ONLY £13.19.6** P. & P. 3/6.

including all valves and **PRE-FABRICATED FRONT END TURRET.** Incorporates built-in power supplies, tuning indicator and series noise limiter on AM.

Hi-Fi reprint containing complete description, simple comprehensive assembly instructions together with itemised component price list available separately at 3/6 post free.
Demonstrations at both our branches daily.

NOTE:—Please state Local Channels when ordering.

LIMITED SUPPLIES OF THIS FINE AND POPULAR CABINET

Instantly recognised as being of leading **High Quality manufacturers' stock**, this trolley-type cabinet is finished in polished dark walnut. Can easily be adapted to accommodate tape recorder, amplifier, radiogram, etc., etc. External measurements: 24½in. × 16in. × 28in. The whole is mounted upon "easy run" castors. Subject to being unsold **£5/19/6**, plus 15/- C. & P.

THE CLYNE RADIO "DE LUXE" PRINTED CIRCUIT SUPERHET

In response to popular demand we have produced this new Printed Circuit two waveband (Long and Medium) Superhet employing the latest range of miniature highly efficient valves:—**ECH81, EF85** and **ECL80**, plus coated cooled Rectifier. Incorporates Ferrite Rod Aerial and is of unit construction. Designed to have the highest degree of sensitivity and selectivity the performance and quality of output is amazing. T.C.C. condensers are used throughout. Easily constructed in one evening. Choice of three cabinets:—Brown or Ivory Bakelite or wooden Walnut finish. For use on A.C. mains 200/250 v. All necessary components at special inclusive price of **£7/19/6** plus 3/6 P. & P. Instruction Book with itemised price list available separately at 1/6 post free

OUR NEW CRYSTAL TRANSISTOR/RECEIVER

To Build Yourself

This receiver, covering medium waveband which can be assembled in about 1 hour will give amazing volume and tonal quality when used in conjunction with a good aerial and earth. Incorporating PNP Transistor and Germanium Diode. For headphone reception. Included with the kit of parts is a handsome plastic case in black and white, measuring 4½ × 3½ × 1¼in. This case accommodates the complete receiver, including battery. **PRICE OF ALL NECESSARY COMPONENTS 25/-** plus 1/3 P. & P. Lightweight high resistance headphones can be supplied separately at **15/-** pair. If, however, all items purchased together they will be supplied at a **SPECIAL INCLUSIVE PRICE OF 37/6** plus 1/6. P. & P. Optional extra, 100ft. coil single 7/36 coloured P.V.C. covered wire suitable for both aerial and earth, **2/6** only.

RADIO JACK

The latest addition to our comprehensive range of equipment to build yourself. Covers local Medium Wave Stations, variably tuned. Compact self-contained unit requiring only connection to aerial (no power supplies required) for first-class reception when used in conjunction with your tape recorder or high gain amplifier. All necessary components available at a special inclusive price of only **19/6**, plus 1/6 p. & p.

MULLARD 510 HIGH-FIDELITY AMPLIFIER

We are proud to be able to offer our **printed circuit** version of this excellent amplifier, with **ULTRA-LINEAR PUSH-PULL** output stage, giving an exceptionally high quality output of 10 watts (max.). Built-in Controls are provided for independent bass and treble Tone correction to suit all types of signal input. Will match all crystal or high impedance magnetic pick-up heads, **F.M., A.M.** or **A.M./F.M.** tuners or tape recorder output. All required components of best quality to Mullard Spec. are offered at a special **inclusive price of £9/9/- plus 3/6 P. & P.** Instruction Book, containing full constructional details, theoretical, practical wiring diagrams, itemised price list available separately at **3/6**, post free.

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THE COMPONENT SPECIALISTS

SEE ALSO PAGES 130, 131

We have perhaps the most up-to-date valve stocks in the trade. Listed below are fully guaranteed and purchase tax paid, together with all the usual surplus types.

VALVE LIST

new imported valve types.

AC6 (PEN) 6/6	EF80 9/-	UY21 15/-	6AL5 (EB91,	7Y4 8/6
AR8 (HL23DD)	EF85 10/6	UY41 9/-	D77, 6D2) 7/6	8D3 (CV138,
7/6	EF86 15/6	UY85 9/-	6AM5 (EL91,	EP91, Z77,
ARP12(VP23) 5/-	EF89 10/-	VCR97 (full	N77,7D9) 10/6	6AM6, 6F12)
ARP18(KT2) 5/-	EF91 (CV138,	picture) 40/-	6AM6 (CV138,	8/6
ATP4 3/6	Z77, 6AM6,	VCR97 (cut off)	EF91, Z77,	9D6 (EF92
AZ1 11/6	6F12, 8D3) 8/6	6F12, 8D3) 8/6	6AQ5 8/6	W77) 8/6
AZ31 9/-	EF92 (W77,	VCR138 40/-	6AT6 8/-	12AH8 14/6
B36 (12SN7) 15/-	9D6) 8/6	VCR139A 35/-	6AU6 9/6	12A6 7/6
CV6 (E1148,	EL32 6/6	VCR517 35/-	6BA6 8/6	12AT6 10/-
7193, VR135)	EL41 10/6	VP23(AR P12) 5/-	6BE6 8/6	12AT7 (ECC81)
2/6	EL42 12/6	VP41 12/6	6BG6G 14/6	9/-
CV138 (EF91,	EL84 11/6	VR53(EF39) 6/6	6BH6 12/6	12AU7 (ECC82)
Z77, 6AM6,	EL91 (N77,	VR54(EB34) 3/6	6BJ6 12/6	9/-
6F12, 8D3) 8/6	6AM5, 7D9)	VR55(EBC33) 7/6	6BW6 9/6	12AX7 (ECC83)
CV358 (EF37)		VR56(EF36) 5/-	6BW7 9/-	9/-
10/6	EM34 11/6	VR65(SP61) 4/-	6BZ6 9/6	12BA6 10/-
CV1052 (EL32)	EM80 9/-	VR65A(SP41) 4/6	6CH6 12/6	12BE6 10/-
6/6	EM81 10/-	VR91 (EF50 ex	6CW4 17/6	12E1 30/-
D77 (EB91,	EY51 14/6	new Egpt) 4/-	6CY5GT 6/6	12J5GT 6/6
6AL5, 6D2) 7/6	EY86 15/-	VR91 (EF50 Red	6DT6 6/6	12J7GT 10/6
DAC32(18S) 9/-	EZ40 9/-	Sylvania) 5/-	6DT8 (Mullard) 7/6	12K7GT 10/6
DAF91 (1S5) 8/-	EZ80 9/-	VR92(EA50) 2/6	6F13 (CV138,	12K8GT 13/6
DC70 20/-	EZ81 9/6	VR105/30 8/6	6F36 (Sylvania)	12K8(Metal) 12/6
DF91 (1T4) 8/-		VR116 3/6	6F36 (Mullard)	12Q7GT 10/6
DK91 (1R5) 8/6		VR135 (CV6,	6F36 (Brimar)	12SC7 4/-
DK9 10/6		E1148) 2/6	6F36 (Marconi)	12SH7(Metal) 6/6
DAF96 10/6		VR150/30 8/6	6F36 (Osram)	12SH7(Metal) 6/6
DF96 10/6		VT127 6/6	6F36 (Ediswan)	12SK7 7/6
DK96 10/6		VT137 (1620) 5/-	6F36 (Genalex)	12SN7GT 15/-
DL96 10/6		VU39 (R3) 8/-	6F36 (Cossor)	12SQ7 10/-
DL35 8/6		VU111 3/6	6F36 (Metal) 10/-	12SR7 6/6
DL92 (3S4) 7/6		W76 6/6	6F36 (Metal) 6/-	1S7 16/6
DL93 (3A4) 7/6		W77 (EF92,	6H6 (Metal) 3/6	1B6 (Super
DL94 (3V4) 9/-		9D6) 8/6	6F12 (CV138,	PL81) 17/6
DL810 6/6		W81 10/6	EF91, Z77,	1A6G 10/6
DM70 7/6		X65 9/6	6AM6SD3) 8/-	1L6GT 10/-
E1148 (CV6,		X79 12/6	6J4 25/-	1L6G 9/-
7193, VR135)		Y63(6U50) 7/6	6J5GT 4/-	1Y5G 9/-
2/6		Z77 (CV138,	6J5 (Metal) 5/-	1Y5 8/6
EA50(VR92) 2/6		EF91, 6AM6,	6J6 (ECC91) 6/6	1X5 8/6
EA8C80 10/-		6AM5, 7D9) 10/6	6J7GT 6/6	1S5 8/6
EAF42 10/6		6Z4 7/6	6J7GT 7/6	1R5 20/-
EB41 8/6		Z309 12/6	6J7 (Metal) 9/-	5L6GT 10/-
EB91 (D77,		1A3 3/6	6K6GT 6/-	5Y3GT(DET18) 35/-
6AL5, 6D2) 7/6		1A7 12/6	6K7G 4/-	5Z4GT 10/-
EBC33(VR30) 7/6		1C5GT(N14) 11/6	6K7GT 7/-	5Z5GT 10/-
EBC41 10/-		1D8GT 8/6	6K7 (Metal) 7/-	5W4 7/6
EBF80 11/6		1H5 (DAC32) 6/6	6K8G (X65) 7/-	12 6/6
EBF89 10/-		1N5G 10/-	6K8GT 11/-	20S5 10/-
ECC81 (12AT7)		1L4 4/6	6L6G 9/6	20C5 10/-
9/-		1LD5 6/6	6L7 7/-	20L6GT 10/-
ECC82 (12AU7)		1N5GT 10/6	6L18 14/-	25 6/6
9/-		1R5 (DK91) 8/6	6N7GT 7/-	30 8/6
ECC83 (12AX7) 9/-		1S4 (DL92) 7/6	6N8G 4/6	32 12/6
ECC84 10/-		1S5 (DAF91) 8/-	6Q7GT 9/-	47A 30/-
ECC85 10/-		1T4(DF91) 8/-	6SA7 (Metal) 8/6	50 45/-
ECH35 11/6		1U5 9/-	6SG7 (Metal) 7/6	57 (British) 5/-
ECH42 (6D10)		1A6 7/6	6SH7 (Metal) 7/6	57 (U.S.A.) 6/6
11/6		2C26 12/6	6SJ7 10/6	113 75/-
ECH81 11/6		2D21 12/6	6SK7GT 7/6	229B(3E29) 80/-
ECF80 14/6		2X2 4/6	6SL7GT 7/6	230B 5/-
ECF82 12/6		3A5 10/-	6SN7GT 6/6	866A 12/6
ECL80 12/6		3A4(DL93) 7/6	6SL18 14/-	931A 45/-
ECL82 14/6		3D6 25/-	6U7G 7/6	954 3/6
ECL83 17/6		3E29(8329B) 80/-	6SR7 7/6	955 5/-
ECR35 40/-		3Q4 9/-	6S87 7/6	956 3/6
EF36(VR56) 6/6		3Q5 9/-	6U4GT 12/6	1267 18/-
EF37 (CV358)		3S4 (DL92) 7/6	6U8G (Y63) 7/6	1626 (UT127) 8/-
12/6		3V4 (DL94) 9/-	6V6G 6/6	5663 12/6
EF39(VR53) 6/6		5B/254M 12/6	6V6GT 7/6	5687 12/6
EF40 12/6		5U4G 7/6	6X4 6/6	5843 12/6
EF41 11/6		5V4 12/-	6X8GT 7/6	9004 (Rugged
EF42 12/6		5Y3G 8/-	6Z4 6/6	6AM6) 12/6
EF50 (VR91 ex		5Y3GT 8/6	7C5 9/6	9006 (6AM6) 12/6
new Egpt) 4/-		5Z3 9/6	7C6 9/6	7193 (CV6,
EF50 (Sylvania		5Z4G 9/-	7H7 9/6	E1148) 2/6
Red) 5/-		6A8GT 12/6	7D9(EL91, N77,	9001 5/-
EF80 9/-		6AC7 6/6	6AM5) 10/6	9002 6/6
EF84(VR136 7/6		6AG5 7/6	7Q7 9/6	9004 5/6
		6AK5 8/6	787 9/6	

Please add post and packing.

In addition to the above at special prices, we carry a comprehensive stock of all B.V.A. types at current list prices.

NOTE:—CERTAIN OTHER AMERICAN SPECIAL PURPOSE TYPES CAN BE SUPPLIED. ENQUIRIES INVITED.

T.V. TUBES. BRAND NEW. Available at very special prices. By leading manufacturer.

14in Rectangular Tinted. Equiv. MW 36-44 £13/19/6

17in. Equiv. MW 43-69 ..... £15/19/5

TERMS AVAILABLE. Carriage and Packing 15/-. FULL GUARANTEE.

WE CAN RECONDITION YOUR OLD CATHODE RAY TUBE AT THE FOLLOWING PRICES:

12in. £10/10/-; 14in. £12; 17in. £14; 21in. £17/10/-.

The tubes are re-gunned and reconditioned by a method approved by the R.T.R.A. and fully guaranteed for a period of 6 months. Your old tube must be forwarded for reconditioning. Carriage and packing 17/6 extra.

JUST RELEASED! "INTERNATIONAL RADIO TUBE ENCYCLOPAEDIA." World-wide valve data in 14 languages plus English. 63/- plus 3/6 P. & P.

TRANSISTORS ! ! !

SURPLUS—P.N.P.

RED SPOT (Audio/Experimental Applications) ..... 7/6 ea.

WHITE SPOT, R.F. up to 2.5 Mc/s. ..... 15/- ea.

STANDARD—

BRIMAR

T.S.1. ..... 18/- ea.

MULLARD

OC16 Power 3 watt ..... 60/- ea.

OC44 ..... 40/- ea.

OC45 R.F. up to 6 Mc/s. ... 35/- ea.

OC70 ..... 21/- ea.

OC71 ..... 24/- ea.

OC72, matched pair 60/-

NEWMARKET

V6/R2 R.F. up to 4 Mc/s. .. 24/- ea.

V6/R4 R.F. 4-8 Mc/s. ..... 33/- ea.

V6/R8 R.F. 8 Mc/s.-up ..... 40/- ea.

AUDIO

V10/15A ..... 15/- ea.

V15/10P (Power) ..... 30/- ea.

(Data sheets available).

(ALL POST FREE)

★ BARGAIN CORNER ★

CARBON HAND MICROPHONE complete with press to talk switch. Lead and Jack plug 5/- ea. Plus 1/- P. & P.

MORSE KEYS. SUPERIOR QUALITY. Brand New. 2/6 plus 1/- P. & P.

10in. RECOND. GOOD QUALITY LOUDSPEAKER. Complete with O.P. trans. As good as new. 17/6 plus 1/6 P. & P.

12in. BAKERS SELHURST LOUDSPEAKERS. 15 ohm, 15 watt, 30-14,000 cps. Few only. Brand new. £4/10/- plus 2/6 P. & P.

12in. PLESSEY P.M. LOUDSPEAKER. 3 ohm speech coil. Brand new. Only 32/6 plus 2/6 P. & P.

10in. LOUDSPEAKER. Ex-equip. as new. Less transformer. 3 ohm speech coil. 15/- plus 1/6 P. & P.

8in. W.B. Hi-Fi LOUDSPEAKER. Ex-equip. as new. 3 ohm speech coil. Complete with output trans. £1/2/6 plus 2/- P. & P.

1-SECTION WHIP AERIALS. Ideal for ishing rods, etc. Each section 4ft. Only 7/6 set. Plus 2/6 P. & P.

NYLON DRIVE CORD. 12 yd. Reel. Best quality 3/6 plus 6d. P. & P.

PAIR LOW IMPEDANCE HEADPHONES 7/6 pr. **BRAND NEW IMPORTED** High impedance lightweight headphones. Finished in cream. 15/- pr. Both plus 1/- P. & P.

TAYLOR "MONTROSE" POCKET TEST SETTER. Eight ranges AC/DC 3 amp., 300 ma., 30 ma., 6 volt, 30 volt, 150 volt, 300 volt and circuit test. Only 50/- plus 1/6 P. & P. Complete with test leads.

POLYSTYRENE COIL CEMENT. 1/10 per bottle plus 6d. P. & P.

3 VOLT VIBRATOR PACK. Ex-W.D. output 140 v. at 30 mA. Fully smoothed. Use only 6in. × 5in. × 2½in. New condition 12/6. Plus 1/6 P. & P.

No. 38 TRANSMITTER-RECEIVER.

(Popular Walkie-Talkie). We have been most fortunate in obtaining a further supply of these complete stations comprising TX/RX unit, headphones, microphone, aerial, junction box, battery satchel and full operating instructions. Range: approx. 5 miles. Frequency coverage 7.4-9 mc/s. ABSOLUTELY BRAND NEW. 65/-. (Batteries not supplied). Export enquiries invited.

No. 18 TRANSMITTER/RECEIVER UNIT

We have just taken delivery of a quantity of these fine units, brand new and complete. This is a very good portable, self-contained transmitter/receiver designed for short range telephony and C.W. Ranges approx. 5 miles. Frequency coverage 6 mc/s.-9 mc/s. All accessories supplied, i.e., Headphones, Mike, Morse Key, Aerial, comprehensive instruction book with circuit diagram. Valve line-up: 3 A.R.P. 12, 2 A8H, 1 ATP4. Weight approx. 22lb. Dimensions (overall): 8in. × 16in. × 17in. UNREPEATABLE at 99/6 plus 7/6 C. & P. (Batteries not supplied.)

A CONSTRUCTORS' MUST!
THE LATEST "PIFCO" INSTRUMENT BIT SOLDERING IRON
With integral Stand and built-in Spotlight for illuminating work. 200/250 v. ONLY 22/6. P. & P. 1/6.

EX-W.D. FIELD TELEPHONE SETS. POWER NO. 1 MK. II. As new, complete with handset, bell and buzzer. £3 each or £5/10/- pair.

EX-W.D. DON MK. V FIELD TELEPHONE SET. Complete with handset, buzzer hand generator, morse key. £3 each or £5/10/- pair.
(Both above plus 2/6 P. & P.)

60 YARD METAL DRUMS OF TWIN TELEPHONE CABLE. Suitable for use with above telephones. 7/6 drum, plus 1/6 P. & P.

OCTAL PLUGS, EX. EQUIP. 9d. ea. plus P. & P. 6d.

PACKARD BELL PRE-AMPLIFIER UNIT. Complete with 6SL7GT and 2S1D7 Pluge. hand switch, many components contained in useful metal case. Brand new, boxed and complete with circuit diagram and instruction-book. Only 12/6 plus 1/6 P.P.

TRANSFORMER SPECIAL. Superior quality half shrouded drop thro' Mains Transformer. Input 200/250 v. Output 350-0-350 v. 80 mA.; 6.3 v. 3 amps. 5 v. 2 amps. Ex-equipment but guaranteed O.K. Only 9/6 plus 1/- P. & P.

METER SPECIAL. We have a limited quantity of aircraft electrical thermometers, by Weston. 2in. moving coil meter, flush square fitting. These meters have a luminous scale graduated 40-140 degrees centigrade, but the full-scale deflection is approximately 150 microamps. Price 12/6 each only, plus 1/- P. & P.

POWER PACK. By leading manufacturer, input 200/250 v. Output 350-0-350 200 mA., 6.3 v., 8 a., 6.3 v. 2 a., 4 v. 7 a., 5 v. 2 a. Fully smoothed. Incorporates valve rectifier GZ32. Chassis measures 13in. × 7in. × 6in. Wt. 22lb. Few only at £4/19/6 plus 3/6 P. & P.

6in. GOOD QUALITY EXTENSION LOUDSPEAKER in attractive Bakelite Cabinet (Black or Brown). Complete with input socket and two wander plugs. Slightly shop soiled. Guaranteed working order. ONLY 27/6 plus 1/6 P. & P.

CRYSTAL MIC. INSERTS. Ex-equip. but perfect. 4/6 each. Plus 9d. P. & P.

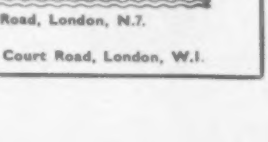
WIRING WIRE. 5 coils 10 yards each in different colours contained in cellophane bag. 5/- bag plus 9d. postage.

12 VOLT VIBRATOR PACK. Mallory. Output 180 v. 40 mA. Complete with synchronous Vibrator. Brand new 12/6. Plus 1/6 P. & P.

24 VOLT ROTARY CONVERTERS. Input 24 v. D.C. Output 200/250 v. A.C. 100 watts. Complete in black steel box 18in. × 11½in. × 8in. Weight approx. 30lb. Completely smoothed. Incorporates Sodium Lamp transformer. Brand new 92/6.

CLAROSTAT GANGED POTS. Dual 250 K ohm, Dual 500 K ohm, or Dual 1 megohm. 7/6 each, plus 9d. P. & P.

SPECIAL PURCHASE from MINISTRY BRAND NEW No. 17 Mk. II TRANSMITTER RECEIVER.



Built into strong wooden cabinet 15in. × 14in. × 9in. Complete with headphones and microphone. Range 5-8 miles with simple aerial. Frequency coverage 44-61 mc/s. (5-7 meters). Uses standard 120 v. H.T. and 2-volt L.T. batteries. Complete with full operating instructions. 59/6. (Batteries not supplied.)

CLYNE RADIO LTD.

162 Holloway Road, London, N.7.
and
18 Tottenham Court Road, London, W.1.

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit and for C.R. Tubes with failing emission.

Type A. Low Leakage windings. Optional Boost 25% and 50%. Tapped mains primaries.

2 volt	12/6 each
4 volt	12/6 each with Tag.
6.3 volt	12/6 each Panel and
10.5 volt	12/6 each Solder Tags
13.5 volt	12/6 each

Type B. Mains input. Low Capacity. Multi Output 2, 4, 6.3, 7.5, 10 and 13 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes, 21/-.

Type C. Low capacity quality transformer for use with 2 volt Tubes with failing emission. Mains input. Output 2-2½-2½-2 volts at 2 amps. 17/6 each.

RESISTORS. All preferred values. 20%, 10 ohms to 10 meg., ½ w. 4d.; 1 w., 6d.; 1½ w., 9d.; 2 w., 1/-. HIGH STABILITY. ½ w., 1%, 2/-. All preferred values 100 ohms to 10 meg. Ditto 5%, 9d.; 10%, 6d.

WIRE-WOUND RESISTORS

8 watt	1/3
10 watt	1/6
15 watt	2/-

25 ohms—10,000 ohms

15,000 ohms—50,000 ohms 5w., 1/9; 10w. 2/3

WIRE-WOUND POTS. 3 WATT LAB. COLVERN, ETC.

Pre-set Min. T.V. Type	Standard size Pots., 2½in.
Knurled Slotted knob.	Spindle Hirb Grade. All
All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-.	Values 100 ohms to 50 K., 5/6; 100 K., 6/6.
Ditto Carbon Track 50 K. to 2 Meg., 3/-.	W/W. EXT. SPEAKER CONTROL 10Ω, 3/-.

O/P TRANSFORMERS. Heavy Duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Miniature 3W4, etc., 4/6. Hyrrade Push-pull 10 watts, 15/6. MULLARD "510" 6k or 8k 30/-. L.F. CHOKES 15/10H 60/65 ma., 5/-. 10H 85 ma., 10/6. 10H 150 ma. 14/-. 5H 250 ma. 16/6.

MAINS TRANSFORMERS 200/250 v. A.C.

STANDARD 250-0-250, 90 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. tapped, 5 v. or 4 v. 2 a.	22/6
Ditto 350-0-350	22/6
MINIATURE, 200 v. 30 mA., 6.3 v. 1 a.	10/6
MIDGET, 250 v. 45 mA., 6.3 v. 2 a.	15/6
SMALL, 250-0-250, 50 mA., 6.3 v. 2 a.	17/6
STANDARD, 250-0-250, 60 mA., 6.3 v. 3.5 a.	17/6
HEATER TRANS. 6.3 v. 1½ a. 7/6 2 amp.	10/6

ALADDIN FORMERS and cores. ½in. 9d.; ⅝in. 10d. 0.3in. FORMERS 5037/6 and Cans TV1/3. ½in. sq. × 2½in. and ½in. sq. × 1½in. 2/- complete with cores.

SLOW MOTION DRIVES. Epicyclic ratio 6 : 1. 2/3.

TYANA. Midget Soldering Iron. 200/250 v. or 220/250 v., 16/9.

SOLON INSTRUMENT IRON. 25 w., 24/-.

MAINS DROPPERS. 2 × 1½in. Three Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.

LINE CORD. .3 amp., 60 ohms, per foot, .2 amp., 100 ohms per foot, 2 way, 6d. per foot, 3 way, 7d. per foot.

CRYSTAL MIKE INSERT by Acos 6/6

Precision engineered. Size only ½ × ⅜in. Bargain. ACOS CRYSTAL DESK MIKE, 33-2, switched, 35/-.

MIKE TRANSF. 50 : 1, 3/9 ea.; 100 : 1, Potted, 10/6.

LOUDSPEAKERS P.M. 3 OHM. 9½in. and 8in., 17/6

6in. × 4in. Rola, 16/-. 7in. × 4in. Goodmans 21/-

10in. × 6in. R.A. 27/6. 8in. Plessey, 19/6

6½in. Rola 16/6. 10in. R.A., 30/-

4in. HI-FI TWEETERS, 25/-. 12in. Plessey, 30/-

12in. Baker 15 wt. 3 ohm, and 15 ohm models 105/-

12in. 15 ohm. Plessey 10 wt. with Tweeter, 97/6

I.F. TRANSFORMERS 7/6 pair

465 kc/s. slug tuning miniature can 2½ × 1 × 1in. High Q and good band width. By Pye Radio. Data sheet supplied.

Wearite M500 I.F. Miniature 465 kc/s. 12/6 pair.

Wearite 550 I.F. Standard 465 kc/s. 12/6 pair.

CRYSTAL DIODE G.E.C. 2/-, GEX34, 4/-. 40 Circuits, 3/-. H.R. HEADPHONES. 4,000 ohms, brand new. 16/6 pair. SWITCH CLEANER Fluid, squirt spout, 4/3 tin.

TWIN GANG CONDENSERS. 365 p.f. Miniature, 11in. × 1¼in. × 1¼in., 10/-. .0005 Standard with trimmers, 9/-; less trimmers, 8/-. Midget, 7/6; Single 50 p.f., 2/6; 100 pf., 7/-. Solid Dielectric 100, 200, 500 pf., 3/6.

VALVE HOLDERS. Pax int. Oct., 4d. EF50, EA50, Ot. B12A, UKT, 1/3. Eng. and Amer. 5, 6, 7 and 9 pin, 1/-. MOULDED Mazda and Int. Oct., 6d., B7G, B8A, B9G, B9A, 9d. B7G with can, 1/6; B12A, 1/3. B9A with can, 2/6. CERAMIC, EF50, B7G, B9A, Oct., 1/-. B7G with can, 1/9. SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-, 25in. × 35in., 10/-. Expanded metal, Silver 15½in. × 9½in., 2/-. Tygan 54in. wide, 10/- ft. 27in. wide, 5/- ft. Samples.

WAVECHANGE SWITCHES

2 p 2-way, 3 p. 2-way, short spindle	2/6
5 p. 4-way 2 wafer, long spindle	6/6
2 p. 6-way, 4 p. 3-way, 4 p. 3-way, long spindle	3/6
3 p. 6-way, 1 p. 12-way, long spindle	3/6

Wave change "MAKITY" 1 wafer 2/6; 2 wafer 12/6; 3 wafer 16/-; 4 wafer 19/6; 5 wafer 23/-; 6 wafer 26/6.

TOGGLE SWITCHES. S.P., 2/-; D.P. 3/6; D.P.D.T., 4/-.

MORSE KEYS, good quality 7/6.

GOLTOP TRANSISTORS

Product of the Pye Group

JUNCTION TYPE P.N.P.

Complete Data Supplied

AUDIO V.10/15in suitable for high gain and low frequency amplifiers, and for output stages giving up to 250 milliwatts in push pull. PRICE **15/-**

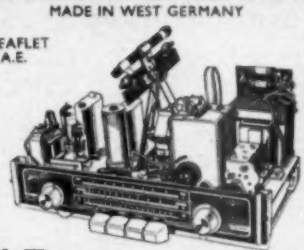
R.F. V.6/12 suitable for oscillators, frequency changers and I.F. amplifiers, cut off frequency 3 Mc/s. average. PRICE **24/-**

Power V15/10P up to 10W., 20/-.

CONTINENTAL SIEMENS "NORA" AM-FM RADIOGRAM 3 Watt CHASSIS

MADE IN WEST GERMANY

LEAFLET S.A.E.



15 gns. Carr. & insurance 5/-.

FM-VHF 87 to 108 Mc/s. Interference Free Medium 185 to 588 m. Long 857 to 2140 m. 5 valves ECC85, ECH81, EF89, EABC80 EL95, metal rectifier, isolated chassis, A.C. 100-250 v. 17 tuned circuits, A.V.C. and negative feedback, ferrite aerial. Tone and volume controls switching on-off, Med., Long, VHF, Pick-up. Dial 11 × 2in., colour brown, figures gold. Chassis 12½ × 6in. height 7½in. Sockets for connections. Instruction manual. Indoor VHF dipole aerial 9/6. Feeder 300 ohm 6d. yd. **SPEAKERS**- 8in. 17/6, 10in. 25/-. H.P. Dep. £8/1/- and eight monthly o £1

1959 RADIOGRAM CHASSIS FINEST VALUE

THREE WAVEBANDS	FIVE VALVES
S.W. 16 m.—60 m.	LATEST MULLARD
M.W. 200 m.—550 m.	ECH42, EF41, EBC41.
L.W. 800 m.—2,000 m.	EL41, EZ40

12 month Guarantee. A.C. 200/250 v., 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative feedback. 4.2 watts. Chassis 13½in. × 5½in. × 2½in. Gram Dial 12½ × 5½in. horizontal or 10 × 4½in. vertical. 2 Pilot Lamps. Four Knobs, Walnut or Ivory, aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9.10.0 Carr. 4/6.

TERMS: Deposit £5/5/- and 5 monthly payments of £1. MATCHED SPEAKERS 8in., 17/6; 10in. 25/-; 12in. 30/-.

★ **GARRARD 4-SPEED RECORD CHANGERS RC120/H MKII MODELS** ★

Brand new and fully guaranteed 12 months.

AUDIO PERFECTION

Designed to play 16, 33, 45, 78 r.p.m. Records 7in., 10in., 12in. Lightweight Xtal pick-up, GC2 head, two separate sapphire styli, for Standard and L.P.

OUR PRICE **£10.15.0** each. Post Free.

Terms: Deposit £5/10/- and 6 monthly payments of £1.

EXCEPTIONAL OPPORTUNITY

COLLARO 4-speed MODEL 4/544 Single Player, heavyweight turntable and lightweight Studio O Pick-up with turnover Xtal mounted on baseplate. Autostop fitted. **6gns.** Carr. 4/-

OUR PRICE

Amplifier Player Cabinets, 45/-.

★ **COLLARO** ★

HIGH-FIDELITY AUTOCHANGER

Mixer Model RC456

4-SPEEDS—10 RECORDS

With Studio "O" pick-up

BRAND NEW IN MAKER'S BOXES

OUR PRICE **£8-5-0** post free

B.S.R. MONARCH UA8 4-SPEED AUTOMATIC RECORD CHANGERS

Brand new and fully guaranteed 12 months.

OUR PRICE **£6-19-6** post free

THE HI-GAIN BAND 3 PRE-AMP.

Cascade circuit using Valve ECC84. Complete kit 29/6 less power; or 49/6 with power pack kit. Plans only 6d. Also Band I version same Prices.

Volume Controls

Midget size

Long spindles. Guaranteed 1 year. All values 5 K. ohms to 2 Meg.

No Switch D.P.Sw. 3/- 4/9

Linear or Log Tracks

80 ohm CABLE Coaxial

Semi-air spaced Polythene insulated 1in. dia. Stranded core. Ideal Band III Losses cut 50%. 9d. yd.

FRINGE QUALITY

AIRSPACED .... 1/6 yd.

COAXIAL PLUGS 1/- DOUBLE SOCKET 1/3

SOCKETS 1/- OUTLET BOXES 4/6

BALANCED TWIN FEEDER per yd. 6d. 300Ω or 300Ω TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohm.

TRIMMERS, Ceramic, 30, 50, 70 pf., 9d. 100 pf., 150 pf. 1/3. 250 pf., 1/6. 500 pf., 750 pf., 1/9. Philips, 1/- ea.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled with 4 sides, riveted corners and lattice fixing holes, with 2in. sides. 7 × 4in. 1/6; 9 × 7in., 5/9; 11 × 7in., 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 18 × 14in., 12/6; and 18 × 16 × 3in., 1P/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.

P.V.C. CONN. WIRE, 9 colours, single or stranded, 24 yd.

NEON MAINS TESTER SCREWDRIVERS, 5/-.

CORED SOLDER RADIOGRADE 1 yds. 9d. 1 lb. 2/6.

PAXOLIN SHEET, 6in. × 10in., 1/6. OIL TRAPS 5/-

12/6 PURETONE RECORDING TAPE

1,200 ft. Paper tape on 7in. metal reels.

Spare Reels 5½in. plastic, 3/-; 7in. plastic, 4/-.

SUPERIOR 1,200ft. Plastic Tape 21/- on 7in. plastic reels. Quality guaranteed.

"INSTANT" Bulk Tape Eraser, 200/50v A.C. For any make and size of tape.

MERCURY RECTIFIERS. H.T. TYPE FLY-BACK VOLTAGES. KS/25 7 kV., 5/-; KS/40 3.2 kV., 7/-; KS/45 3.6 kV., 7/6; KS/80 v. 4 kV., 8/-; KS/160 9 kV., 14/6. 50 c.p.s. Voltage 30% of above.

MAINS TYPE. RM1. 125 v. 60 mA. 5/-; RM3. 180 mA. 6/-; RM5. 150 mA., 8/-; RM4. 250 v. 275 mA., 16/-.

MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA. 7/6; 60 mA. 8/6; 85 mA. 9/6.

COILS. Wearite "P" type, 3/- each. Osmor Midget "Q" type adj dust core from 4/- each. All ranges.

TELETRON. L. and Med. T.R.F., with reaction, 3/6.

FERRITE ROD AERIALS. M.W. 6/9; M. and L. 12/6.

T.R.F. COILS A.H.P. 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET, 26/-. H.F. coil aerial coil. Oscillator coil, two I.F. Transformers 10.7 Mc/s. Detector transformer and heater choke. Circuit and component book using four 6AM6. 2/-. Complete kit with Jason Calibrated dial and 4 valves, £6/15/-.

Mercury Switched FM Tuner 5 valve Kit, £9/19/6

Mullard 3-3 quality Amplifier. Ready built, £7/17/6

CONDENSERS. New stock. .001 mfd. 7 kV. T.C.C., 5/6. Ditto 20 kV., 9/6; 100 pf. to 500 pf. Micas, 9d.; Tubular 500 v., .001 to .01 mfd., 9d.; .02 to .1 1/-; 350 v. .1 1/9; .1 350 v., 9d.; 0.1 mfd., 2,000 v., 3/6; 0.01 mfd., 2,500 v. 1/9

CERAMIC CONDS. 500 v. .3 pf. to .01 mfd., 10d.

SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/- 600 pf. to 2,000 pf. 1/3.

CLOSE TOLERANCE (±1pf.) 1.5 pf. to 47 pf., 1/6 DITTO 1% 50 pf. to 815 pf. 1/9; 1,000 pf. to 5,000 pf. 2/-.

NEW ELECTROLYTICS. FAMOUS MAKES.

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	64/350 v.	5/6	8/500 v.	3/-
2/450 v.	2/3	100/25 v.	2/-	16/500 v.	4/-
4/450 v.	2/3	250/25 v.	2/6	32/350 v.	4/-
8/450 v.	2/3	500/12 v.	2/-	100/270 v.	5/6
8/500 v.	2/3	8+8/450 v.	4/6	2,500/3 v.	4/-
16/450 v.	3/6	8+8/500 v.	5/-	6,000/6 v.	7/-
16/500 v.	4/-	8+16/450 v.	5/-	8+16/500 v.	7/-
32/450 v.	5/6	8+16/500 v.	5/6	32+32/350 v.	4/6
25/25 v.	2/-	16+16/450 v.	5/6	50+50/350 v.	7/-
50/25 v.	2/-	16+16/500v	6/-	64+120/350 v.	11/6
50/50 v.	2/-	32+32/350v	4/6	100+200/275v.	12/6

FULL WAVE BRIDGE SELENIUM RECTIFIERS 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6

CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v. 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Charger circuit free. AMPHENOLS, 4 a. and 8 a., 14/6.

All brand VALVES 90 day guarantee

1R5	8/6	6L6	10/6	EA50	1/6
1S5	8/6	6N7M	7/6	EABC80	10/6
1T4	8/6	6Q7	10/6	EB91	6/6
2X2	2/6	6SA7	10/6	EBC33	8/6
3S4	8/6	6SJ7M	10/6	EBC41	10/6
3V4	8/6	6SN7	8/6	EBF80	10/6
5U4	8/6	6V6G	7/6	ECC84	12/6
5Y3	8/6	6X4	7/6	ECF80	11/6
5Z4	10/6	6X5	7/6	ECF82	11/6
6AM6	8/6	787	10/6	ECH42	10/6
6BE6	7/6	12AH8	10/6	ECL80	12/6
6BH6	10/6	12AT7	10/6	EF39	7/6
6BW6	10/6	12AU7	9/6	EF41	10/6
6D6	7/6	12AX7	9/6	EF50	5/6
6F6	7/6	12BE6	9/6	EF50	8/6
6F8	8/6	12K7	9/6	6y/v.	
6J5	6/6	12Q7	9/6	EF80	10/6
6J6	7/6	35L6	9/6	EF92	5/6
6J7	6/6	35Z4	9/6	EL32	5/6
6K6	6/6	80	10/6	EL84	10/6
6K7	5/6	807	9/6	EZ40	10/6
6K8G	8/6	954	1/6	EZ80	9/6

UBC41 10/6; UCH42 10/6; UF41 10/6; UL41 10/6; UY41 10/6; U25 10/6

We have no connection with any other firm. Please address all Mail Orders correctly as below.

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE RD., WEST CROYDON

OPEN ALL DAY—(Wed. 1 p.m.) *Catalogue 6d.*

TEL. THO 1665. Buses 133 or 68 pass door. S.R. Stn. Selhurst P. & P. 1/-, £2 orders post free. C.O.D. Service 1/6. (Export C.W.O. pac extra, no H.P.)

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

SEE ALSO PAGES 130, 131

We have perhaps the most up-to-date valve stocks in the trade. Listed below are new imported valve types, fully guaranteed and purchase tax paid, together with all the usual surplus types.

VALVE LIST

AC6 (PEN)	6/6	EF80	9/-	UY21	15/-	6AL5 (EB91,	
AR8 (HL23DD)	7/6	EF85	10/6	UY41	9/-	D77, 6D2)	7/6
ARP12(VP23)	5/-	EF86	15/6	UY85	9/-	6AM5 (EL91,	
ARP18(KT2)	5/-	EF89	10/-	VCR97 (full		N77,7D9)	10/6
ATP4	3/6	EF91 (CV138,		picture)	40/-	6AM6 (CV138,	
AZ1	11/6	Z77, 6AM6,		VCR97 (cut off)	40/-	EF91, Z77,	
AZ31	9/-	6F12, 8D3)	8/6	VCR138	40/-	6F12, 8D3)	8/6
B36 (12SN7)	15/-	EF92 (W77,		VCR139A	35/-	6AQ5	8/6
CV6 (E1148,		9D6)	8/6	VCR517	35/-	6AT6	8/-
7193, VR135)	2/6	EL32	6/6	VP23(ARP12)	5/-	6AU6	9/6
CV138 (EF91,		EL41	10/6	VP41	12/6	6B8G	4/6
Z77, 6AM6,		EL42	12/6	VR53(EF39)	6/6	6BA6	8/6
6F12, 8D3)	8/6	EL84	11/6	VR54(EB34)	3/6	6BE6	8/6
CV358 (EF37)	10/6	EL91 (N77,		VR55(EBC33)	7/6	6BG6G	14/6
	12/6	6AM5, 7D9)	10/6	VR56(EF36)	5/-	6BH6	12/6
CV1052 (EL32)	6/6	EM34	11/6	VR65(SP61)	4/-	6BJ6	12/6
D77 (EB91,		EM80	9/-	VR65A(SP41)	4/6	6BW6	9/6
6AL5, 6D2)	7/6	EM81	10/-	VR91 (EF50 ex		6BW7	9/-
DAC32(HL3)	9/-	EY51	14/6	new Eqpt)	4/-	6BR7	12/6
DAF91 (1S5)	8/-	EY86	15/-	VR91 (EF50 Red		6CH6	17/6
DC70	20/-	EZ40	9/-	Sylvania)	5/-	6C4	6/-
DF91 (1T4)	8/-	EZ80	9/-	VR92(EA50)	2/6	6C5 (Metal)	7/6
DK91 (1R5)	8/6	EZ81	9/6	VR105/30	8/6	6C5GT	6/6
DK9	10/6	FW4/500		VR116	3/6	6C6G	5/-
DAF96	10/6		12/6	VR135 (CV6,		6C9	10/6
DF96	10/6	VU8,VU20)	11/6	E1148)	2/6	6D2 (D77, EB91	
DK96	10/6	GZ32 (GZ34)	11/6	VR150/30	8/6	6AL5)	7/6
DL96	10/6	H1,2K(VT50)	5/-	VT127	6/6	6D6	5/-
DL35	8/6	HL23DD (AR8)	7/6	VT137 (1626)	5/-	6F5	6/6
DL92 (3S4)	7/6	KT2(ARP18)	5/-	VU39 (R3)	5/-	6F6	6/6
DL93 (3A4)	7/6	KT33C	10/-	VU111	3/6	6F6 (Metal)	10/-
DL94 (3V4)	9/-	KT61	14/6	W76	6/6	6F7	6/6
DL810	6/6	KT66	15/-	W77 (EF92,		6H6 (Metal)	3/6
DM70	7/6	ML4	5/-	9D6)	8/6	6F12 (CV138,	
E1148 (CV6,		ML6(VT105)	6/6	W81	10/6	EF91, Z77,	
7193, VR135)	2/6	N14(1C3GT)	11/6	X65	10/-	6AM6SD3)	8/6
EA50(VR92)	2/6	N77 (EL91,		X79	12/6	6J4	25/-
EABC80	10/-	AM5, 7D9)	10/6	Y63(U5G)	7/6	6J5GT	4/6
EAF42	10/6	OZ4	7/6	Z77 (CV138,		6J5 (Metal)	5/-
EB41	8/6	PCC84	11/6	EF91, 6AM6,		6J6 (ECC91)	6/6
EB91 (D77,		PCF80	13/6	6F12, 8D3)	8/6	6J7G	7/6
6AL5, 6D2)	7/6	PCF82	13/6	1A3	3/6	6J7GT	7/6
EBC33(VR53)	7/6	PCL82	13/6	1A7	12/6	6J7 (Metal)	9/6
EBC41	10/-	PCL83	17/6	1C5GT(N14)	11/6	6K6GT	6/6
EBF80	11/6	PEN36	6/6	1D8GT	8/6	6K7G	4/6
EBF89	10/-	PEN45	16/6	1E5 (DAC32)	9/-	6K7GT	7/6
ECC81 (12AT7)	9/-	PL81	16/6	1L4	4/6	6K7 (Metal)	7/6
ECC82 (12AU7)	9/-	PL82	10/6	1LD5	6/6	6K8G (X65)	7/6
	9/-	PL83	11/6	1N5GT	10/6	6K8GT	11/6
ECC83		PM2A	6/6	1R5 (DK91)	8/6	6L6G	9/-
(12AX7)	9/-	PM2B2	8/6	1S4	6/6	6L7	7/6
ECC84	10/-	185(DAF91)	8/-	1S5 (DAF91)	8/6	6L18	14/-
ECC85	10/-	1T4(DF91)	8/-	1T4(DF91)	8/-	6N7GT	7/6
ECH35	11/6	1U5	9/-	1U5	9/-	6Q7GT	9/-
ECH42 (6010)	11/6	1A6	7/6	1A6	7/6	6SA7 (Metal)	8/6
ECH81	11/6	X26	11/6	X26	11/6	6SG7 (Metal)	7/6
ECF80	14/6	2D21	12/6	2D21	12/6	6SH7 (Metal)	7/6
ECF82	13/6	2X2	4/6	2X2	4/6	6SJ7	10/6
ECL80	13/6	3A5	10/-	3A5	10/-	6SK7GT	7/6
ECL82	14/6	3A4(DL93)	7/6	3A4(DL93)	7/6	6SL7GT	7/6
ECL83	17/6	3B25	25/-	3B25	25/-	6SN7GT	6/6
ECR35	40/-	3E29(929B)	80/-	3E29(929B)	80/-	6SR7	7/6
EF36(VR54)	6/6	3Q4	9/-	3Q4	9/-	6SS7	7/6
EF37 (CV358)	12/6	3Q5	9/-	3Q5	9/-	6U4GT	12/6
EF39(VR53)	6/6	3S4	7/6	3S4 (DL92)	7/6	6U5G (Y63)	7/6
EF40	12/6	3V4 (DL94)	9/-	3V4 (DL94)	9/-	6V6G	6/6
EF41	11/6	5B/254M	12/6	5B/254M	12/6	6V6GT	7/6
EF42	12/6	5U4G	7/6	5U4G	7/6	6X4	6/6
EF50 (VR91 ex		5V4	12/-	5V4	12/-	6X5GT	7/6
new Eqpt)	4/-	5Y3G	8/-	5Y3G	8/-	6Z4	6/6
EF50 (VR91 Red		5Y3GT	8/6	5Y3GT	8/6	7C5	9/6
Sylvania)	5/-	5Z3	9/6	5Z3	9/6	7C6	9/6
EF80 (VR92 ex		5Z4G	9/-	5Z4G	9/-	7H7	9/6
new Eqpt)	4/-	6AM2T	12/6	6AM2T	12/6	7199(EL91, N77,	
EF80 (Sylvania		6AC7	6/6	6AC7	6/6	6AM5)	10/6
Red)	5/-	6AG5	7/6	6AG5	7/6	7Q7	9/6
EF84(VR136	7/6	UL41	10/6	6AK5	8/6	787	9/6

7Y4	8/6	9D6 (EF92	
8D3 (CV138,		W77)	8/6
EF91, Z77,		12AH8	14/6
6AM6, 6F12)	8/6	12AU6	7/6
9D6 (EF92		12AT6	10/-
W77)	8/6	12AT7 (ECC81)	9/-
12AH8	14/6	12AU7 (ECC82)	9/-
12AU6	7/6	12AX7 (ECC83)	9/-
12AT6	10/-	12BA6	10/-
12AT7 (ECC81)	9/-	12BE6	10/-
12AU7 (ECC82)	9/-	12E1	30/-
12AX7 (ECC83)	9/-	12J5GT	6/6
12BA6	10/-	12J7GT	10/6
12BE6	10/-	12K7GT	10/6
12E1	30/-	12K8GT	13/6
12J5GT	6/6	12K8 (Metal)	12/6
12J7GT	10/6	12Q7GT	10/6
12K7GT	10/6	12SC7	4/6
12K8GT	13/6	12SJ7 (Metal)	6/6
12K8 (Metal)	12/6	12SH7 (Metal)	6/6
12Q7GT	10/6	12SK7	7/6
12SC7	4/6	12SN7GT	15/-
12SJ7 (Metal)	6/6	12SQ7	10/-
12SH7 (Metal)	6/6	12SR7	6/6
12SK7	7/6	1A7	12/6
12SN7GT	15/-	1C5GT	10/6
12SQ7	10/-	1D8GT	8/6
12SR7	6/6	1L6	9/-
12SJ7 (Metal)	6/6	1LD5	6/6
12SK7 (Metal)	6/6	1LN5	10/6
12SN7 (Metal)	6/6	1N5GT	10/6
12SQ7 (Metal)	6/6	1R5	8/6
12SR7 (Metal)	6/6	1S4	6/6
12V6	6/6	1S5	8/6
12Y4	9/6	1T4	8/-
20D1	12/6	1U5	9/-
20F2	12/6	2D21	12/6
20L1	12/6	3A5	10/-
20P1	12/6	3Q4	9/-
20P3	12/6	3Q5	9/-
20P4	12/6	3S4	7/6
20P5	12/6	3V4	9/-
20P5GA	12/6	5U4G	7/6
20P5GB	12/6	5V4	12/-
20P5GT	12/6	5Y3G	8/-
20P5GTA	12/6	5Y3GT	8/6
20P5GTB	12/6	5Z3	9/6
20P5GTC	12/6	5Z4G	9/-
20P5GTD	12/6	6AC7	6/6
20P5GTE	12/6	6AG5	7/6
20P5GTF	12/6	6AK5	8/6

Please add post and packing.

In addition to the above at special prices, we carry a comprehensive stock of all B.V.A. types at current list prices.

NOTE:—CERTAIN OTHER AMERICAN SPECIAL PURPOSE TYPES CAN BE SUPPLIED. ENQUIRIES INVITED.

T.V. TUBES. BRAND NEW. Available at very special prices. By leading manufacturer.
14in Rectangular Tinted. Equiv. MW 36-44 ..... £13/19/6
17in. Equiv. MW 43-69 ..... £15/19/5

TERMS AVAILABLE. Carriage and Packing 15/-. FULL GUARANTEE.

WE CAN RECONDITION YOUR OLD CATHODE RAY TUBE AT THE FOLLOWING PRICES:
12in. £10/10/-; 14in. £12; 17in. £14; 21in. £17/10/-.
The tubes are re-gunned and reconditioned by a method approved by the R.T.B.A. and fully guaranteed for a period of 6 months. Your old tube must be forwarded for reconditioning. Carriage and packing 17/6 extra.

JUST RELEASED: "INTERNATIONAL RADIO TUBE ENCYCLOPAEDIA." World-wide valve data in 14 languages plus English. 63/- plus 3/6 P. & P.

—TRANSISTORS ! ! !—

SURPLUS—P.M.P.
RED SPOT (Audio/Experimental Applications) ..... 7/6 ea.
WHITE SPOT, R.F. up to 2.5 Mc/s. ..... 15/- ea.
STANDARD—
BRIMAR
T.8.1. ..... 18/- ea.
MULLARD
OC16 Power 3 watt ..... 60/- ea.
OC44 ..... 40/- ea.
OC45 R.F. up to 6 Mc/s. .. 35/- ea.
OC70 ..... 21/- ea.
OC71 ..... 24/- ea.
OC72, matched pair 60/-
NEWMARKET
V6/R2 R.F. up to 4 Mc/s. .. 24/- ea.
V6/R4 R.F. 4-8 Mc/s. ..... 33/- ea.
V6/R8 R.F. 8 Mc/s.-up .... 42/- ea.
AUDIO
V10/15A ..... 15/- ea.
V15/10P (Power) ..... 30/- ea.
(Data sheets available).
(ALL POST FREE)

★ BARGAIN CORNER ★

CARBON HAND MICROPHONE complete with press to talk switch. Lead and Jack plug 5/- ea. Plus 1/- P. & P.

MORSE KEYS. SUPERIOR QUALITY. Brand New. 2/6 plus 1/- P. & P.

10in. RECOND. GOOD QUALITY LOUDSPEAKER. Complete with O.P. trans. As good as new. 17/6 plus 1/6 P. & P.

12in. BAKERS SELHURST LOUDSPEAKERS. 15 ohm, 15 watt, 30-14,000 cps. Few only. Brand new. £4/10/- plus 3/6 P. & P.

13in. PLESSEY P.M. LOUDSPEAKER. 3 ohm speech coil. Brand new. Only 32/6 plus 2/6 P. & P.

10in. LOUDSPEAKER. Ex-equip, as new. Less transformer. 3 ohm speech coil. 15/- plus 1/6 P. & P.

Mn. W.B. Hi-Fi LOUDSPEAKER. Ex-equip, as new. 3 ohm speech coil. Complete with output trans. £1/2/6 plus 2/- P. & P.

3-SECTION WHIP AERIALS. Ideal for fishing rods, etc. Each section 4ft. Only 7/6 set. Plus 2/6 P. & P.

NYLON DRIVE CORD. 12 yd. Reel. Best quality 3/6 plus 6d. P. & P.

CLR LOW IMPEDANCE HEADPHONES 7/6 pr. **BRAND NEW IMPORTED** High impedance lightweight headphones. Finished in cream. 15/- pr. Both plus 1/- P. & P.

TAYLOR "MONTROSE" POCKET TEST METER. Eight ranges AC/DC 3 amp., 300 ma., 30 ma., 6 volt, 30 volt, 150 volt, 300 volt and circuit test. Only 50/- plus 1/6 P. & P. Complete with test leads.

POLYSTYRENE COIL CEMENT. 1/10 per bottle plus 6d. P. & P.

6 VOLT VIBRATOR PACK. Ex-W.D. Input 140 v. at 30 mA. Fully smoothed. Size only 6in. × 3in. × 2½in. New condition 12/6. Plus 1/6 P. & P.

No. 38 TRANSMITTER/RECEIVER

(Popular Walkie-Talkie). We have been most fortunate in obtaining a further supply of these complete stations comprising TX-RX unit headphones, microphone, aerial, junction box, battery satchel and full operating instructions. Range: approx. 5 miles. Frequency coverage 7.4-9 mc/s. ABSOLUTELY BRAND NEW. 65/-. (Batteries not supplied). Export enquiries invited.

No. 18 TRANSMITTER/RECEIVER UNIT

We have just taken delivery of a quantity of these fine units, brand new and complete. This is a very good portable, self-contained transmitter/receiver designed for short range telephony and C.W. Range: approx. 5 miles. Frequency coverage 6 mc/s.-9 mc/s. All accessories supplied, i.e., Headphone, Mike, Morse Key Aerial, comprehensive instruction book with circuit diagram. Valve line-up: 3 A.R.P. 12, 2 AR8, 1 ATP4. Weight approx. 22lb. Dimensions (overall): 8in. × 18in. × 17in. UNREPEATABLE at 99/6 plus 7/6 C. & P. (Batteries not supplied.)

A CONSTRUCTORS' MUST !
THE LATEST "PIFCO" INSTRUMENT BIT SOLDERING IRON
With integral Stand and built-in Spotlight for illuminating work. 200/250 v. ONLY 22/6. P. & P. 1/6.

EX-W.D. FIELD TELEPHONE SETS. POWER NO. 1 MK. II. As new, complete with handset, bell and buzzer. £3 each or 25/10/- pair.

EX-W.D. DOM MK. V FIELD TELEPHONE SET. Complete with handset, buzzer hand generator, morse key. £3 each or £5/10/- pair.
(Both above plus 2/6 P. & P.)

60 YARD METAL DRUMS OF TWIN TELEPHONE CABLE. Suitable for use with above telephones. 7/6 drum, plus 1/6 P. & P.

OCTAL PLUGS, EX. EQUIP. 9d. ea. plus P. & P. 6d.

PACKARD BELL PRE-AMPLIFIER SHIP. Complete with 6BL7GT and 2/6D7 Pings, band switch, many components contained in useful metal case. Brand new, boxed and complete with circuit diagram and instruction book. Only 12/6 plus 1/6 P.P.

TRANSFORMER SPECIAL. Superior quality half shrouded drop thro' Mains Transformer. Input 200/250 v. Output 350-0-350 v. 80 mA.; 6.3 v. 3 amps. 5 v. 2 amps. Ex-equipment but guaranteed O.K. Only 9/6 plus 1/- P. & P.

METER SPECIAL. We have a limited quantity of aircraft electrical thermometers, by Weston. 2in. moving coil meter, flush square fitting. These meters have a luminous scale graduated 40-140 degrees centigrade, but the full-scale deflection is approximately 150 microamps. Price 12/6 each only, plus 1/- P. & P.

POWER PACK. By leading manufacturer. Input 200/250 v. Output 350-0-350 250 mA., 6.3 v., 8 a., 6.3 v. 2 a., 4 v. 7 a., 5 v. 2 a. Fully smoothed. Incorporates valve rectifier GZ32. Chassis measures 13in. × 7in. × 5½in. Wt. 22lb. Few only at 64/19/6 plus 3/6 P. & P.

9in. GOOD QUALITY EXTENSION LOUDSPEAKER in attractive Bakelite Cabinet (Black or Brown). Complete with input socket and two wander plugs. Slightly shop soiled. Guaranteed working order. ONLY 27/6 plus 1/6 P. & P.

CRYSTAL MIC. INSERTS. Ex-equip, but perfect. 4/6 each. Plus 9d. P. & P.

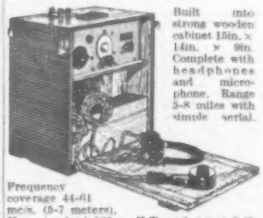
WIRING WIRE. 5 coils 10 yards each in different colours contained in cellophane bag. 5/- bag plus 9d. postage.

12 VOLT VIBRATOR PACK. Mallory. Output 150 v. 40 mA. Complete with synchronous Vibrator. Brand new 12/6. Plus 1/6 P. & P.

94 VOLT ROTARY CONVERTERS. Input 24 v. D.C. Output 200/250 v. A.C. 100 watts. Complete in black steel box 18½in. × 11½in. × 8in. Weight approx. 30lb. Completely smoothed. Incorporates 8volium Lamp transformer. Brand new 92/6.

CLAROSTAT GANGED POTS. Dual 250 K ohm, Dual 500 K ohm, or Dual 1 megohm. 7/6 each, plus 9d. P. & P.

SPECIAL PURCHASE from MINISTRY BRAND NEW No. 17 Mk. II TRANSMITTER/RECEIVER.



Built into strong wooden cabinet 15in. × 14in. × 9in. Complete with headphones and microphone. Range 5-8 miles with simple aerial. Frequency coverage 44-61 mc/s. (5-7 meters). Uses standard 120 v. H.T. and 2-volt L.T. batteries. Complete with full operating instructions. 59/6. (Batteries not supplied.)

CLYNE RADIO LTD.

162 Holloway Road, London, N.7.
and
18 Tottenham Court Road, London, W.1.

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater-Cathode short circuit and for C.R. Tubes with falling emission.
Type A. Low Leakage windings. Optional Boost 25% and 50%. Tapped mains primaries.

2 volt	12/6 each
4 volt	12/6 each with Tag.
6.3 volt	12/6 each Panel and
10.8 volt	12/6 each Solder Tags
13.3 volt	12/6 each

Type B. Mains input. Low Capacity. Multi Output 2, 4, 6.3, 7.3, 10 and 12 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes, 21/-.
Type C. Low capacity quality transformer for use with 2 volt Tubes with falling emission. Mains input. Output 2-2½-2½-3 volts at 2 amps. 17/6 each.

RESISTORS. All preferred values. 20% 10 ohms to 10 MEG. ½ w. 6d.; 1 w., 9d.; 1½ w., 9d.; 2 w., 1/-. HIGH STABILITY. ½ w., 1%, 2/-. All preferred values 100 ohms to 10 meg. Ditto 5%, 9d., 10%, 6d.

WIRE-WOUND RESISTORS
5 watt 1/3
10 watt 1/6
15 watt 2/-
15,000 ohms—50,000 ohms 5w., 1/0; 10w. 2/3
WIRE-WOUND POTS. 2 WATT LAB. COLVERN, ETC.
Pre-set Min. T.V. Type Knurled Slotted knob. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-. Ditto Carbon Track 50 K. to 2 Meg., 3/-.
Standard size Pots., 2½in. Spindle High Grade. All Values 100 ohms to 50 K., 5/6; 100 K., 6/6.
W.W. ETC. SPEAKER CONTROL 10Ω., 3/-.

O/P TRANSFORMERS. Heavy Duty 30 mA., 4/6. Multi-ratio push-pull, 7/6. Miniature 3W4, etc., 4/6. Hycrade Push-pull 10 watts, 15/6. MULLARD "510" 4x or 8x 30/-. L.F. CHOKES 15/10H 60/65 ma., 8/-. 10H 85 ma., 10/6. 10H 150 ma. 14/-. 5H 250 ma. 16/6.

MAINS TRANSFORMERS 200/250 v. A.C.
STANDARD 250-0-250, 80 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. tapped, 5 v. or 4 v. 2 a. 22/6
ditto 250-0-350 ..... 22/6
MINIATURE, 200 v. 30 mA., 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA., 6.3 v. 2 a. 15/6
SMALL, 220-0-220, 50 mA., 6.3 v. 2 a. 17/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a. ... 17/6
HEATER TRANS. 6.3 v. 1½ a. 7/6 2 amp. .. 10/6

ALADDIN FORMERS and cores. ½in. 9d.; ⅝in. 10d. O.8in. FORMERS 5637/8 and Cans TV1/2. ½in. sq. × 9/16in. and ⅝in. sq. × 1⅛in. 2/- complete with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
TYANA. Midget Soldering Iron, 200/230 v. or 220/250 v., 16/9.
ERSIN SOLDER INSTRUMENT IRON. 25 w. 24/-.
MAINS DROPPERS. 3 × 1½in. Three Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms, per foot, .3 amp., 100 ohms per foot, 2 way, 6d. per foot. 3 way, 7d. per foot.

CRYSTAL MIKE INSERT by Acos 6/6
Precision engineered. Size only ½ × ⅝in. Bargain.
ACOS CRYSTAL DESK MIKE, 53-2, switched. 35/-

MIKE TRANSF. 50 : 1, 3/9 ea.; 100 : 1, Potted. 10/6
LOUDSPEAKERS P.M. 3 OHM. 2½in. and 5in., 17/6
6in. × 4in. Rola, 18/-. 7in. × 4in. Goodmans 21/-
10in. × 6in. R.A. 27/6. 8in. Plessey, 19/6
6½in. Rola, 13/6. 10in. R.A., 30/-
9in. TI-PI TWEETERS, 25/-. 12in. Plessey, 30/-
12in. Baker 15 wt. 8 ohm, and 15 ohm models 105/-
12in. 15 ohm. Plessey 10 wt. with Tweeter, 97/6

I.F. TRANSFORMERS 7/6 pair
465 kc/s. slug tuning miniature can 2½ × 1 × 1in. High Q and good band width. By Pye Radio. Data sheet supplied.
Wearite M300 I.F. Miniature 465 kc/s. 12/6 pair.
Wearite 550 I.F. Standard 465 kc/s. 12/6 pair.

CRYSTAL DIODE G.E.C. 2/-. GEX34, 4/-. 40 Circuits, 3/-.
H.R. HEADPHONES. 4,000 ohms, brand new. 16/6 pair.
SWITCH CLEANER Fluid, sweet spray, 4/3 tin.
TWIN GANG CONDENSERS. .005 p.f. Miniature, 1⅛in. × 1½in. × 1½in. 10/-. .0005 Standard with trimmers, 9/-; less trimmers, 8/-. Midget, 7/6; Single 50 p.f., 2/6; 100 pf., 2/-. Solid Dielectric 100, 300, 500 pf., 3/6.
VALVE HOLDERS. Pax int. Oct., 4d. EF50, EA50, 9d. B12A, CR7, 1/3. Eng. and Amer. 4, 5, 6, 7 and 9 pin, 1/-. MOULDED Mazda and Int. Oct., 6d., B7G, B8A, B8G, B9A., 9d. B7G with can, 1/6; B12A, 1/3. B9A with can, 2/6. CERAMIC, EF50, B7G, B9A, Oct., 1/-. B7G with can, 1/9. SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-. 25in. × 36in., 10/-. Expanded metal, Silver 16⅔in. × 9½in., 2/-. Tyran 54in. wide, 10/- ft. 27in. wide, 5/- ft. Samples.
WAVECHANGE SWITCHES
2 p 2-way, 3 p. 2-way, short spindle 2/6
5 p. 4-way 2 wafer, long spindle 6/6
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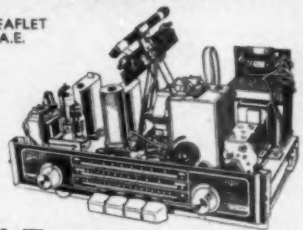
3 p. 4-way, 1 p. 12-way, long spindle 3/6
Wave change "MAKITE" 1 wafer 5/6; 2 wafer 12/6; 3 wafer 16/-; 4 wafer 19/6; 5 wafer 23/-; 6 wafer 26/6.
TOGGLE SWITCHES. S.P., 2/-; D.P. 3/6; D.P.D.T., 4/-.
MORSE KEYS, good quality 9/6.

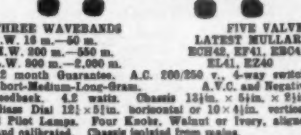
GOLTOP TRANSISTORS
Product of the Pye Group
JUNCTION TYPE P.N.P.
Complete Data Supplied
AUDIO V.10/15a suitable for high gain and low frequency amplifiers, and for output stages giving up to 250 milliwatts in push pull. PRICE 15/-
R.F. V.6/R2 suitable for oscillators, frequency changers and I.F. amplifiers, cut off frequency 5 Mc/s. average. PRICE 24/-
Power V15/10P up to 10W., 20/-.

CONTINENTAL SIEMENS "NORA" AM-FM RADIOGRAM 3 Watt CHASSIS
MADE IN WEST GERMANY
LEAFLET S.A.E.



15 gns. Carr. & insurance 5/-.
FM-VHF 87 to 108 Mc/s. Interference Free Medium 185 to 588 m. Long 857 to 2140 m. 5 valves ECC85, ECH81, EF89, EABC80 EL95, metal rectifier, isolated chassis, A.C. 100-250 v. 17 tuned circuits, A.V.C. and negative feedback, ferrite aerial. Tone and volume controls switching on-off, Med., Long, VHF, Pick-up. Dial 11 × 2in., colour brown, figures gold. Chassis 12½ × 6in. height 7½in. Sockets for connections. Instruction manual. Indoor VHF dipole aerial 9/6. Feeder 300 ohm 6d. yd. SPEAKERS- 8in. 17/6, 10in. 25/-. H.P. Dep. £3/1/- and eight monthly o £1

1959 RADIOGRAM CHASSIS
FINEST VALUE



THREE WAVEBANDS
S.W. 16 m.—50 m.
M.W. 200 m.—550 m.
L.W. 800 m.—2,000 m.
12 month Guarantee. A.C. 200/250 v., 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative feedback. 4.2 watts. Chassis 13½in. × 5½in. × 2½in. Glass Dial 12½ × 5½in. horizontal or 10 × 4½in. vertical. 2 Pilot Lamps. Four Knobs, Walnut or Ivory, aligned and calibrated. Chassis isolated from mains.
FIVE VALVES
LATEST MULLARD ECH42, EF41, EBC41. EL41, EZ40
BRAND NEW £9.10.0 Carr. 4/6.
TERMS: Deposit £5/5/- and 5 monthly payments of £1.
MATCHED SPEAKERS 8in., 17/6; 10in. 25/-; 12in. 30/-.

★ GARRARD 4-SPEED RECORD CHANGERS RC120/H MKII MODELS ★
Brand new and fully guaranteed 12 months.
AUDIO PERFECTION
Designed to play 16, 33, 45, 78 r.p.m. Records 7in., 10in., 12in. Lightweight Xtal pick-up, GC2 head, two separate sapphire styli, for Standard and L.P.
OUR PRICE £10.15.0 each. Post Free.
Terms: Deposit £5/10/- and 6 monthly payments of £1.

EXCEPTIONAL OPPORTUNITY
COLLARO 4-speed MODEL 4/544 Single Player, heavyweight turntable and lightweight Studio O Pick-up with turnover Xtal mounted on baseplate. Autostop fitted. 6gns. Carr. 4/-
OUR PRICE
Amplifier Player Cabinets, 45/-.

★ COLLARO ★
HIGH-FIDELITY AUTOCHANGER
Mixer Model RC456
4-SPEEDS—10 RECORDS
With Studio "O" pick-up
BRAND NEW IN MAKER'S BOXES
OUR PRICE £8-5-0 post free

B.S.R. MONARCH UA8 4-SPEED AUTOMATIC RECORD CHANGERS
Brand new and fully guaranteed 12 months.
OUR PRICE £6-19-6 post free

THE HI-GAIN BAND 3 PRE-AMP.
Cascode circuit using Valve ECC84. Complete kit 29/6 less power; or 49/6 with power pack kit. Plans only 6d. Also Band I version same Prices.

Volume Controls
Midget size
Long spindles. Guaranteed 1 year. All values 5 K. ohms to 2 Meg. No Switch D.P.Sw. 3/- 4/9
Linear or Log Tracks

80 ohm CABLE Coaxial
Semi-air spaced Polythene insulated ⅛in. dia. Stranded core. Ideal Band III 9½d. Loses cut 50%. yd.
FRINGE QUALITY A'SPACED .... 1/6 yd.

COAXIAL PLUGS 1/- DOUBLE SOCKET 1/3
SOCKETS 1/- OUTLET BOXES 4/6
BALANCED TWIN FEEDER per yd. 6d. 80Ω or 300Ω.
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohm.
TRIMMERS, Ceramic, 30, 50, 70 pf., 9d. 100 pf., 150 pf. 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Philips, 1/- ea.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled with 4 sides, riveted corners and lattice fixing holes, with 2in. sides. 7 × 4in., 5/6; 9 × 7in., 5/9; 11 × 7in., 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 18 × 14in., 12/6; and 18 × 16 × 3in., 1P/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, 9 colours, single or stranded, 24 yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE 7 yds. 9d. 1 lb. 9/6.
PAXOLIN SHEET, 6in. × 10in., 1/6. 'ON TRAPS 5/-

12/6 PURETONE RECORDING TAPE
1,200 ft. Paper tape on 7in. metal reels.
Spare Reels 5½in. plastic, 3/-; 7in. plastic, 4/-.
SUPERIOR 1,200ft. Plastic Tape 21/- on 7in. plastic reels. Quality guaranteed.
"INSTANT" Bulk Tape Eraser, 200/250v A.C. For any make and size of tape.

SENTERCEL RECTIFIERS. E.H.T. TYPE FIVE-BACK VOLTAGES. K3/25 7 kV., 5/-; K3/40 3.2 kV., 7/-; K3/45 3.6 kV., 7/6; K3/60 v. 4 kV., 8/-; K3/100 8 kV., 14/6. 50 c.p.s. Voltage 30% of above.
MAINS TYPE. RM1, 125 v. 60 mA. 5/-; RM2, 100 mA., 6/-; RM3, 120 mA., 8/-; RM4, 250 v. 275 mA., 16/-.
MINIATURE CONTACT COOLED RECTIFIERS.
6 v. 50 mA. 7/6; 60 mA. 8/6; 85 mA. 9/6.
COILS. Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.
TELETRON. L. and Med. T.R.F. with reaction, 4/6.
FERRITE ROD AERIALS. M.W. 6/9; M. and L. 12/6.
T.R.F. COILS A/HF 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET, 26/-. H.F. coil aerial coil Oscillator coil, two I.F. Transformers 10.7 Mc/s. Detecto transformer and heater choke. Circuit and component book using four 6AM6, 2/-. Complete kit with Jason Calibrated dial and 4 valves, 26/15/-.
Mercury Switched FM Tuner 5 valve Kit, 29/19/6
Mullard 3-3 quality Amplifier. Ready built, 27/17/6

CONDENSERS. New stock. .001 mfd. 7 kV. T.C.C., 5/6. Ditto 20 kV., 9/6; 100 pf. to 500 pf. Mica, 6d.; Tubular 500 v. .001 to .01 mfd., 9d.; .02 .1 1/-; .25 1/6; .5 1/9; .1/350 v., 9d.; 0.1 mfd., 5,000 v., 3/6; 0.01 mfd., 2,500 v. 1/9
CERAMIC CONDS. 500 v .5 pf. to .01 mfd., 10d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/- 600 pf. to 2,000 pf., 1/3.
CLOSE TOLERANCE (±1pf.) 1.5 pf. to 47 pf., 1/6 DITTO 1% 50 pf. to 815 pf. 1/9; 1,000 pf. to 5,000 pf. 2/-

NEW ELECTROLYTICS. FAMOUS MAKES.

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	64/350 v.	5/6	8/500 v.	3/-
2/450 v.	2/3	100/25 v.	2/-	16/500 v.	4/-
4/450 v.	2/3	250/25 v.	2/6	32/350 v.	4/-
8/450 v.	2/3	500/12 v.	2/-	100/270 v.	5/6
8/500 v.	2/9	8+8/450 v.	4/6	2,500/3 v.	4/-
16/450 v.	3/6	8+8/500 v.	5/-	6,000/6 v.	5/-
16/500 v.	4/-	8+16/450 v.	5/-	8+16/500 v.	7/-
32/450 v.	5/6	8+16/500 v.	5/6	32+32/350 v.	4/6
25/25 v.	2/-	16+16/450 v.	5/6	50+50/350 v.	7/-
50/25 v.	2/-	16+16/500 v.	6/-	64+150/350 v.	11/6
50/50 v.	2/-	32+32/350v.	4/6	100+300/275v.	12/6

FULL WAVE BRIDGE SELENIUM RECTIFIERS 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6
CHARGER TRANSFORMERS Tapped input 200/250 v. for charging at 2, 6 or 12 v. 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Charger circuit free. AMMETERS, 4 a. and 8 a., 14/6.

All boxed VALVES 90 day guarantee

1B3	8/6	6L6	10/6	EA50	1/6
1R5	8/6	6S7M	7/6	EABC80	10/6
1T4	8/6	6Q7	10/6	EB91	6/6
2X2	8/6	6SA7	10/6	EBC33	8/6
3S4	8/6	6SJ7M	10/6	EBC41	10/6
3V4	8/6	6SN7	8/6	EBF80	10/6
5U4	8/6	6V6G	7/6	ECC84	12/6
5Y3	8/6	6X4	7/6	ECF80	11/6
5Z4	10/6	6X5	7/6	ECF82	11/6
6AM6	8/6	787	10/6	ECH42	10/6
6BE6	7/6	12AH8	10/6	ECL82	12/6
6BH6	10/6	12AT7	10/6	EF39	7/6
6BW6	10/6	12AU7	9/6	EF41	10/6
6D6	7/6	12AX7	9/6	EF80	5/6
6F6	7/6	12BE6	9/6	EF85	8/6
6H6	3/6	12K7	8/6	6ytv.	
6J5	6/6	12Q7	8/6	EF89	10/6
6J6	7/6	35L6	9/6	EF92	5/6
6J7	8/6	35Z4	9/6	EL32	5/6
6K6	6/6	90	10/6	EL84	10/6
6K7	5/6	807	6/6	EZ40	10/6
6K8G	8/6	954	1/6	EZ80	9/6
				EZ81	11/6
				HABC80	12/6
				HVR2A	7/6
				MU14	10/6
				P61	6/6
				PCC84	12/6
				PCF80	11/6
				PCF82	11/6
				PCL82	11/6
				PEN25	6/6
				PL82	10/6
				PY80	10/6
				PY81	10/6
				PY82	10/6
				8P61	6/6
				UBC41	10/6
				UCH42	10/6
				UF41	10/6
				UL41	10/6
				UY41	10/6
				U22	10/6

We have no connection with any other firm. Please address all Mail Orders correctly as below.

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE RD., WEST CROYDON
OPEN ALL DAY—(Wed. 1 p.m.) Catalogue 6d.
TEL. THO 1665. Buses 133 or 68 pass door. S.R. Stn. Selhurst P. & P. 1/-, £2 orders post free. C.O.D. Service 1/6. (Export C.W.O. plus extra, no H.P.)

RECORD PLAYER CABINET 79/6. A delightful looking cabinet 14½ × 17½ × 8½in. deep, in 2-tone leatherette. Will take a B.S.R. Monarch 4 speed autochanger and 6½in. round speaker. Carr. and Ins. 4/6.

RECORD PLAYER CABINET 79/6. Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours (red and grey). Grilled front controls panel. Size 15 × 19 × 8½in. deep. Beautifully made. A cabinet you can really be proud of. Takes 4 speed B.S.R. Autochanger. 6½in. round or elliptical speaker. Room for any amplifier of your own choice. Carr. and Ins. 4/6.

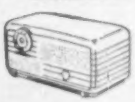
RECORD PLAYER CABINET 69/6. A beautifully styled cabinet. Made by a famous manufacturer. In polka dot grey cloth with clipped lid and carrying handle. Size: 16 × 14½ × 8½in. deep. Will take a B.S.R. Monarch 4 speed Autochanger and 4 × 7in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins. 4/6.

EXTENSION SPEAKERS 19/9

Polished wood cabinet of attractive appearance. Fitted with 8in. P.M. speaker, W.B. or Goodmans of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Ins. & Carr. 3/6.

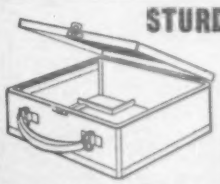
Ideal for Stereophonic Sound: 8in. P.M. Speakers 8/9. With O.P. Transformer fittad 10/-. 6½in. P.M. Speakers 12/6. Postage 2/9. 4 × 7in. elliptical speakers 19/6.

BAKELITE CABINETS 9/9



Brand new. Colour brown. Attractive design. Size 12in. × 7in. × 5½in. Ideal for small receivers, convertors, etc. P. & P. 3/9.

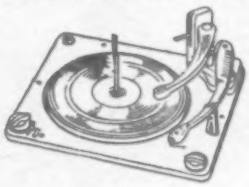
STURDY CASE 12/6



8½ × 7½ × 3½in. deep. Covered in burgundy and grey washable rexine. Strong clasp, hinges and handle. Ideal for Portable Radio Chassis or Transistor set. Can be adapted as a Record carrying case to hold eighteen 7in. long-playing records. P. & P. 2/6.

MOTOR BOARDS 2/6. For 4-speed Autochangers. P. & P 1/3.

COLLARO 4 SPEED AUTOCHANGERS £7.19.6

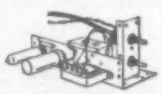


Incorporating auto and manua contro complete with studio crystal p.u. and sapphire stylus. Also other makes at similar prices. P. & P. & Ins. 5/6.

B.S.R. MONARCH 4 SPEED AUTOCHANGERS. 66/19/6. Incorporating auto and manual control complete with turnover crystal p.u. and sapphire stylus. P.P. & Ins. 5/6.

AMPLIFIERS

12 MONTHS' GUARANTEE



PORTABLE AMPLIFIER MARK D.I. 59/6

Brand new. Latest design with printed circuit. Dimensions 7 × 2½ × 5in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MARK D.2. 79/6.

Printed circuit. Latest design. Dimensions 7 × 2½ × 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MARK D.3. 89/6.

De luxe model. Printed circuit. Latest design. Dimensions 7 × 2½ × 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume, treble and bass controls. Knobs 3/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MARK D.4. 69/6

Brand new. By famous manufacturer. Especially built for portable record players. Dimensions: 4½ × 3½ × 4in. A.C. only. 2 valves—EL84 as high gain output valve, EZ80 as rectifier. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

STEREOPHONIC AMPLIFIER £7/19/6.

12 months' guarantee. Beautifully made for portable stereophonic record players. Latest design with printed circuit. Dimensions 3 × 5½ × 9¾in. A.C. only. Mains isolated. Twin amplifiers each side giving 3-4 watts output. Incorporating ECL82 triode pentode valve. Full tone, volume and balance controls. Complete and ready to fit. Knobs 3/6 per set extra. P.P. & Ins. 4/6.

RECORD PLAYER CABINET. 59/6. A well designed cabinet in brown leatherette. Strong clip fasteners, easy carrying handle. Takes B.S.R. Monarch and space for a 4 × 7in. elliptical speaker. Can be made up into an ideal Record Player. Size 16 × 14½ × 8½in. deep. Carr. & Ins. 4/6.

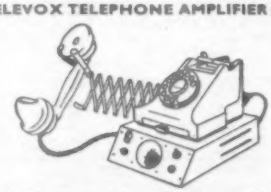
RECORD PLAYER CABINET 49/6. A practical cabinet, nicely designed, cloth covered two-tone (brown and coffee). Size: 15 × 17 × 8in. deep. Takes B.S.R. 4 speed autochanger and 6½in. round or elliptical speaker. Carr. & Ins. 4/6.

RECORD PLAYER CABINET 39/6

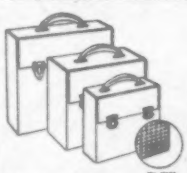
Latest contemporary style rexine covered cabinet in two tone colour scheme. Hinged clipped lid, carrying handle. Space available for all modern amplifiers and autochangers etc. Size: 19½ × 15½ × 9in. Carr. & Ins. 4/6.

Many other types of beautifully designed cabinets in stock at similar prices to the above.

TELEVOX TELEPHONE AMPLIFIER 89/6



Invaluable in a noisy office or workshop. 3 valves UY41, UF41, UL41. 3in. speaker and a suction type vibration microphone. A.C./D.C. Size of amplifier 7 × 11 × 3in. Fits any type of G.P.O. telephone. P.P. & Ins. 4/6.



RECORD PRESENTATION CASES

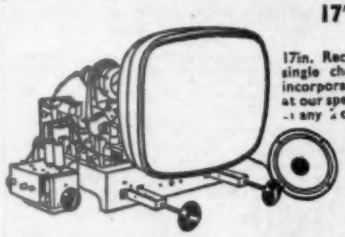
Beautifully made, strong modern cases covered in hardwearing washable rexine or leatherette. Choice of many colours—please state preference. Hinged top for easy access to records. Plated clip fasteners. Quick reference number index. Carry all your records, including very expensive long players, safely to parties and record sessions.

Record Size	No. of records held	Price
12in.	40	46/-
12in.	25	32/6
7in.	40	32/6
7in.	25	31/-

P.P. & Ins. 2/6.

BARGAINS FOR RECORD PLAYER ENTHUSIASTS FROM DUKE & CO.

17" T.V. CHASSIS, TUBE & SPEAKER £19.19.6



17in. Rectangular Tube on modified chassis. Supplied a single channel chassis covering B.B.C. channels 1-5, or, incorporating Turret Tuner which can be added as an extra, at our special price to chassis purchasers of 50/- giving choice of any 4 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12 x 14½ x 11in. less valves. Similar chassis are used by well known companies because of their stability and reliability. With Tube and Speaker £19/19/6. With all valves £25/19/6. Complete and working with Turret Tuner £28/9/6. 12 months guarantee on the Tubes. 3 months guarantee on the valves and chassis Ins. Carr. (incl. Tube) 25/-.

14in. T.V. CHASSIS, TUBE & SPEAKER £15/19/6.
As above with 14in. Rectangular Tube. 12 months guarantee on Tube, 3 months guarantee on chassis and valves. Chassis with Tube and Speaker (less valves) £15/19/6. With all valves £21/19/6. Complete and working with Turret Tuner £24/9/6. Ins. Carr. (incl. Tube) 25/-.

POPULAR 12in. PLESSEY T.V. CHASSIS 39/6.
This is a real bargain for anyone wanting to make up their own T.V. at a very low cost. Easily modified to take a larger Tube and simply adapted for a 12 channel Turret Tuner. A chassis in one unit, believed working. Less Tube, valves, speaker and scanning coils (all can be supplied as extras). Circuit diagram available at 3/6 or FREE with order. Carr & Ins. 10/6.

12in. T.V. CHASSIS 29/6
Complete chassis by famous manufacturer. R.F. E.H.T. unit included. Easily fitted to table or console model, owing to this chassis being in three separate units (power, s/vision strip, t/base interconnected). This chassis is less valves and tube. Speaker Free. I.F.'s 16-19.5 Mc/s. vision. Channels 1—5 easily converted to I.T.A. by use of a Turret Tuner. Drawings available at 2/6 or FREE with order. Ins. Carr. 10/6. 12in. Tube available at £6 plus Ins. Carr. 15/6.

12 CHANNEL TURRET TUNER £6/17/6
Supplied with two channels (Band I and Band III) I.F.'s 9.5—11.5 Mc/s. 13-15 Mc/s vision. Flat to .25 db. over range. Power supply required:—200 H.T. 6.3 v. L.T. Combined aerial input. Parallel heaters. (2 valves included.) Extra channels 7/6, post FREE.

T.V. AERIALS 25/6. For all I.T.A. channels. Outdoor or loft. 3 elements. P. & P. 2/6.

AERIALS 15/9. B.B.C. indoor type. Folded dipole with 12ft. Co-ax cable fitted. Post 1/9.

T.V. AERIALS 7/9. For all channels. Complete with co-ax cable for use indoors or in the loft. Postage 1/3.

ELECTRIC CONVECTOR HEATER 99/6

Even if your local council have not yet taken action, don't be a SMOG offender. With our Electric Convector Heaters you will make neither your home nor the air dirty. And they are so economical to run too! A.C./D.C. switched for 1 or 2 kW. Illuminated grille. Size 26in. x 18in. x 7½in. deep. Ins. Carr. 10/6.

SOUND/VISION & I.F. STRIP 25/6. Plessey. Tested. I.F.'s 10.5 Mc/s sound. 14 Mc/s vision. 8 valve holders. Less valves. Size 8½ x 5 x 4½in. Circuit incl. The Tuner unit plugs directly into this chassis. P. & P. 2/6.

SOUND/VISION & I.F. STRIP 10/6. Salvaged. Complete sound and vision strip. 8 valve holders. Less valves. I.F.'s 16-19 Mc/s. Size 8½ x 4½ x 4½in. Drawings free with order. P. & P. 2/6.

SOUND/VISION & I.F. STRIP 10/6. Salvaged. Superhet. 8 valve holders. Less valves. I.F.'s 7.25 Mc/s sound. 10.75 Mc/s vision. Vision complete from input up to video output. Sound complete from input to A.F. Amplifier. P. & P. 2/6.

SOLO SOLDERING TOOL 12/6

110 v., 6 v., or 12 v. Special adaptor for 200/240 v. 10/- extra. Automatic solder feed including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post 2/9.

REGETTERED IMPROVED VACUUM T.V. TUBES.

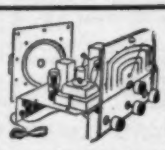
17" £7.10.0; 14" £5.10.0

12 months guarantee

Our 12 months guarantee (6 months full replacement, 6 months progressive) illustrates our wholehearted confidence in the Tubes we offer. We sell many hundreds a week throughout the country and have done so for the past 7 years. Many of them go to the Trade, i.e. Insurance Companies, Renters and Retailers who are thoroughly satisfied with our supplies. Remember they also hold a 10 days money back guarantee.

9in., 10in., 14in., 15in., and 16in. Round Tubes. Our special offer of these sizes £5. 12in. T.V. Tubes £6. Three months guarantee on Round Tubes. Ins. Carr. 15/6.
14in. Rectangular T.V. Tubes with burns 30/-. Ideal as a standby or for testing purposes. Carriage 10/-.

EXPRESS DESPATCH SERVICE. Please 'phone to confirm Tube in stock. Send Telegraph Money Order. Tube despatched Passenger Train same day.



SUPER CHASSIS 99/6
5 valve superhet chassis including 8in. P.M. speaker and valves. Four control knobs (tone, volume, tuning w/change switch). Four w/bands with position for gram p.u. and extension speaker. A.C. inc. Carr. 5/6.

IDEAL CHASSIS 39/6
5 valve superhet. A.C. Radio or Radiogram chassis. 3 wave bands and gram switched. 8in. P.M. Speaker included. Set of valves 45/9 extra. Chassis size 19½ x 7½ x 9in. Carr. 5/6.

TIMEBASE 4/9
Containing scanning coils focus unit, line transformer etc. Less valves. Drawings free with order. P. & P. 2/6.

SOLDER REELS 1/6. On plastic spools 60-40 3 core Ersin. 20ft. for 1/6. Will fit the Solo Tool. Post 4d.

INSULATING TAPE 1/6. Finest quality. 75ft. x ½in. in sealed metal container. Post on 1 tin 9d. Post on 6 tins 2/-.

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R.F. E.H.T. Not Tested. Amplifier stage 6V6 with O.P. transformer. 3 ohms matching. Smoothed H.T. 350 volt at 250 mA. 6.3 v. at 5 amp. 22 v. at 3 amp. 6.3 v. at 4 amp., and 4 v. centre tapped. Size 14½ x 8 x 7in. Less valves. Drawings free with order. Ins. Carr. 5/6.

POWER PACK AND AMPLIFIER 19/6
Tested. Output stage 6V6 with O.P. trans. (3 ohms) choke. Smoothed H.T. 350 v. at 250 mA. 6.3 v. at 5 amp. 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 v. centre tapped. Less valves. Ins. Carr. 5/6.

POWER PACK AND AMPLIFIER 19/6
Output stage PEN45. O.P. trans. choke. Smoothed H.T. 325 v. at 250 mA. 4 v. at 5 amp. 6.3 v. at 5 amp., 4 v. at 5 amp. centre tapped. Valve base for rectifier, octal or 4 pin. Output is taken from standard plugs. Less valves. Ins. & Carr. 5/6.

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350-0-350 volts at 250 mA., 6.3 volt at 4 amp., 6.3 volt at 4 amp., 4 volt at 3 amp., 22 volt at .3 amp., 4 volt centre tapped at 1.5 amp. Primary 200-250 volt. 50 cycles. P. & P. 3/9.

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350-0-350 volts at 250 mA., 6.3 volt at 5 amp., 4 volt at 4 amp., 4 volt at 7 amp., 4 volt centre tapped at 1 amp. Primary 200-250 volts. 50 cycles. P. & P. 3/9.

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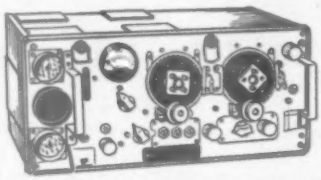

Advantages of the Mk. III over previous models is a much lower battery consumption and control, slow motion tuning, netting switch in place of push button, wider range of note in hot tone control and the incorporation of R.F. gain control.

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BRAND NEW, beautifully built, compact, modern assembly. Scope for 115 or 230 volt A.C. mains.

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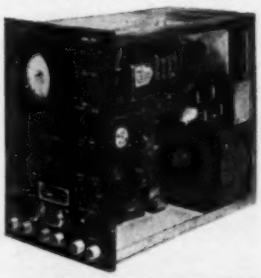

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Tuned resonant cavity accurate to within 10 Mc/s.
Resonance and relative power indicated on microammeter.
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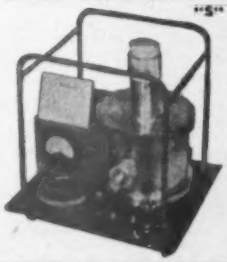

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Two band coverage tunes 750 to 3750 metres. 6 volt input to self contained vibrator and 6X5G power pack (HT transformer can be fed directly from 250v. mains if preferred). Uses seven current 2v. valves, 3×KF3, 3×KBC1 and 1×VP23. Contains also highly sensitive German polarised relay that operates as station is tuned in and out—indicator lamp on panel also goes on and off with carrier or as stations are tuned. Rugged hermetically sealed cast alloy case.

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The FANE 12" H.D. LOUDSPEAKER UNIT

TECHNICAL SPECIFICATION

Diameter over lugs	12¾in.
Overall depth	6¼in.
Power handling	20 watts R.M.S.
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Total flux	160,000 lines
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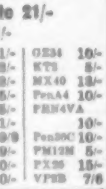

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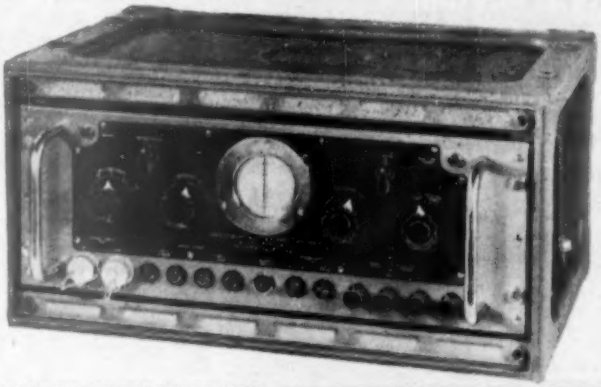
DEMOBBED VALVES MANUAL

2/6

Giving equivalents of British and American Service and Cross Reference of Commercial Types with an Appendix of B.V.A. Equivalents and Comprehensive Price List. We have still some Valves left at very old Budget Rates (33⅓%) which are actually sold at the old price (1951). Also ready our new comprehensive B.V.A. List.

PIFCO Illuminated Soldering Iron

Designed and constructed with a complete understanding of the technical need for making a perfect soldering job in the quickest time. The Pifco Soldering Iron incorporates in its red plastic handle a 6.3 volt lamp directing a beam of light directly on to the soldering point, enabling easy manipulation in the darkest and most difficult places. The lamp also acts as a safety eye ensuring the iron is not left on unintentionally. The bit is 5/16in. diameter and of the pencil type, acknowledged as the most valuable for all general purposes. Chrome plated trivet allows the hot iron to stand on the table or may be used as a hanger. Element 55 watts. Six foot grey 3-core flex fitted. Length 10 inches. For 200/250 volts A.C./D.C. Complete **22/6**



OSCILLOSCOPE No. 11

Made for Anti-Aircraft Command and just released by Ministry of Supply. Manufactured by A. C. Cossor in 1952, this is a First Grade L.F. Oscilloscope incorporating a Hard Valve Time Base, with existing speeds of 1-5-40 milliseconds, but is easily converted at a cost of a few shillings to produce speeds of 3 cycles per second to 30 kc/s. Has High Class Amplifier with Fine and Coarse gain controls, plus Brightness and Focus controls, and X and Y shifts. Conservatively rated Mains Power Pack is for nominal 115 v. and 230 v. input, and is adequately fuse protected in all circuits. Tube employed is 2½in. ACR10. Will make up into an ideal workshop or servicing oscilloscope. Has grey and black engraved front panel size 19in. x 7in., depth of unit being 12in. Illustrated, in heavy steel transit case in which it can be used, or removed for standard 19in. rack mounting. Complete with leads and suggested modification data. BRAND NEW ONLY £12/10/- (carriage 15/-).

MARCONI SIGNAL GENERATOR TF-57I-F/I. Special offer of these Laboratory Signal Generators. Cover 10-18 Mc/s., 33-58 Mc/s. and 150-300 Mc/s. In good, used condition, with charts. Checked before despatch. Complete with power pack for normal A.C. mains. ONLY £12/10/- (carriage etc., 20/-).

H.R.O. MAINS POWER UNITS. Input 115/230 v. A.C. Output 230 v. 75 mA., and 6.2 v. 3.5 Amps. Complete in black crackled case ONLY 69/6 (carriage 3/6).

SPRAGUE CONDENSERS. Metal cased, wire ends. New, .01 mfd. 1,000 v., and .1 mfd. 500 v. 7/6 dozen. Special quotes for quantities.

ROLA 6½in. P.M. SPEAKER. Mounted in grey crackled metal cabinet. 9 x 9 x 4½in. and with volume control. BRAND NEW AND UNUSED. ONLY 27/6.

P.M. SPEAKERS. 3in. 19/6. 6½in. 17/6. 8in. 21/-. 12in. 29/6.

O/P. TRANSFORMER. 5/-

EHT TRANSFORMERS. 5.5 kV. (Rect.) with 2 v. 1 a., 79/6. 7 kV. (Rect.) with 2 v. 1 a., 89/6. 2.5 kV. (Rect.) with 2-0-2 v. 1.1 a., 2-0-2 v. 2 a (for VCR 97 tube etc.), 42/6 (postage 2/- per trans.).

TRAWLER BAND R 1155s

The latest version of this famous Communications Receiver to be released by the Air Ministry. Covers 6 wave ranges: 18.5-7.5 Mc/s., 7.5-3.0 Mc/s. 3.0-1.5 Mc/s., 1.5 Mc/s.-600 kc/s., 600-200 kc/s. As used by Coastal Command, Air-Sea Rescue Launches, etc. All sets thoroughly tested and in perfect working order before despatch, and on demonstration to callers. Have had slight use, but are in excellent condition. ONLY £12/10/6.
"B" Models also available. As above but instead of 3.0-1.5 Mc/s. band has 200-75 kc/s. coverage. ONLY £7/19/6.
A.C. MAINS POWER PACK OUTPUT STAGE, in black metal case to match receiver, enabling it to be operated immediately, by just plugging in, without any modification. Fitted with 5in. P.M. Speaker 66.10/-. DEDUCT 10/- IF PURCHASING RECEIVER AND POWER PACK TOGETHER.
Send S.A.E. for illustrated leaflet, or 1/3 for 14-page booklet which gives technical information, circuits, etc., and is supplied free with each receiver Add carriage 10/6 for Receiver, 5/- for Power Unit.

METERS

F.S.D.	SIZE AND TYPE	PRICE
50 microamps D.C.	2½in. Flush circular	59/6
500 microamps D.C.	2in. Flush circular	17/6
500-0-500 micro D.C.	2½in. Flush circular	27/6
1 mA. D.C.	2in. Flush square	22/6
1 mA. D.C.	2½in. Flush circular	25/-
150 ma. D.C.	2in. Flush square	7/6
200 mA. D.C.	2½in. Flush circular	12/6
1 amp. D.C.	2½in. Proj. circular	12/6
10 amps. D.C.	2½in. Proj. circular	20/-
20 amps D.C.	2in. Proj. circular	7/6
40 amps D.C.	2in. Proj. circular	7/6
15.0-15 amps D.C.	2½in. Flush square	25/-
300 volts D.C.	2in. Flush square	10/6
200 volts A.C.	2½in. Flush circular	22/-
500 volts A.C.	2½in. Flush circular	25/-

R1155 SUPER SLOW MOTION TUNING ASSEMBLY. As used on all late models 1155s. Easily fitted to "A" sets, etc. ONLY 12/6.

MUIRHEAD SLOW-MOTION DRIVES. A really precision product of this famous maker. 3in. in diameter and fitted to removable white backplate marked 0-180. Overall diameter 4in. BRAND NEW IN MAKERS' CARTONS. ONLY 10/6 (post 1/6).

MAINS ISOLATING TRANSFORMER. Manufactured by Vortexion. Fully shrouded. Will provide true 1 : 1 Ratio from nominal 230 v. Primary. Rated at 100 watts. BRAND NEW. ONLY 22/6 (post 2/6).

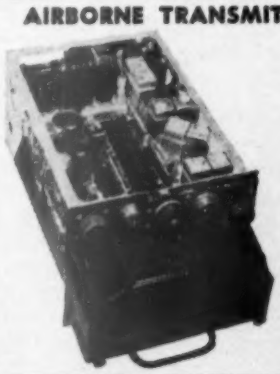
12 VOLTS AMERICAN DYNAMOTOR. Delivers 220 volts at 100 mills. Size 5½ x 3½in. diameter. Ideal for running Radio or Electric Shaver, etc. from car battery. ONLY 32/6.

12-WAY SCREENED CABLE. In 10ft. lengths, fitted with plugs, originally made for use with the 19 Set. UNUSED. ONLY 17/6 per lead.

POCKET VOLTMETERS. Not ex-Govt. Read 0-15 v. and 0-300 v. A.C. or D.C. BRAND NEW and UNUSED. ONLY 18/6.

6 v. VIBRATOR PACKS. Output approx. 130 v. at 30 mA., fully filtered and smoothed. Complete ONLY 12/6.

AIRBORNE TRANSMITTER RECEIVER



Type 1986

A mobile 10 channel crystal controlled V.H.F. Tx./Rx. covering 124.5/156 Mc/s.
I.F. Bandwidth 23 kc/s.
Complete (less external attachments), in metal case, with all valves and 24 volt rotary power unit.
Used but in first-class condition.

ONLY £8/19/6
(carriage etc., 10/6).

HETERODYNE FREQUENCY METERS

TYPE LM14

Designed and built to United States Navy specification, these Crystal Controlled instruments combine all the advantages of the well known BC.221 Frequency Meter, plus many additional features which increase their usefulness.

★ Frequency range 125-20,000 kc/s. in 2 bands.
★ Accuracy better than .02% in 125-2,000 kc/s. band, and better than .01% in 2,000-20,000 kc/s. band.
★ Voltage stabilisation circuit ensures accuracy not affected by power supply fluctuation.
★ Separate power switches allow standby filament operation without HT supply.
★ Modulation switch enables instrument to be used as a Signal Generator.
★ Has corrector for WWV.
★ Supplied with removable shock protection mounting.
★ Size only 8½in. x 8in. x 8½in., weight 11½ lbs.
★ Brand New and Unused. Further details on application.

Cash with order please, and print name and address clearly

PLEASE ADD POSTAGE OR CARRIAGE COSTS ON ALL ITEMS

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ALL POPULAR TYPES OF **Cinch** **COMPONENTS SUPPLIED FROM STOCK**

SPECIAL OFFER OF CURRENT MANUFACTURE ELECTROLYTIC CONDENSERS (tubular wire and P.V.C. sheathed). 8 mfd. 450 v., 2/6 each; 16 mfd. 450 v. 3/-; 32 mfd. 450 v. 4/-; 8 x 8 mfd. 450 v. 3/9; 8 x 16 mfd. 450 v. 4/-; 16 x 16 mfd. 450 v. 4/6; 32 x 32 mfd. 350 v. 5/-.

BIAS CONDENSERS. 2,500 mfd. 3 v. 3/6; 250 mfd. 25 v. 2/-; 100 mfd. 25 v. 1/6; 50 mfd. 12 v. 1/6; 25 mfd. 25 v. 1/6.

ELECTROLYTIC CONDENSERS. Manufacturers' surplus, in perfect condition. 100 mfd. x 200 mfd. 350 v. surge 5/6 each; 100 mfd. x 100 mfd. 425 v. surge 5/6 each; 150 mfd. 450 v. wkg. 5/6 each.

2 mfd. 130 v. Size 2in. x 1¼in. suitable for crossover 1/9 each or 18/- doz.

TRANSISTORS: Junction type Red Spot by well-known manufacturers 10/- each.
TRANSISTOR CONDENSERS: Miniature Electrolytic Capacitors. 32 mfd. 3 v., 25 mfd. 25 v., 25 mfd. 6 v., 16 mfd. 12 v., 8 mfd. 6 v., 5 mfd. 12 v., 2.5 mfd. 25 v. 1.6 mfd. 6 v., 1 mfd. 12 v. All these types of condensers are 3/6 each. SPECIAL DISCOUNTS FOR QUANTITIES.

AIR-SPACED TRIMMERS, 5, 10, 15, 25, 50 and 75 or pre-set and spindle types 2/- each ..... doz. 21/-

MIDGET MICA CONDENSERS. .0001, .0002, .0003, .0004, .0005 5/- per dozen.
200 Assorted Moulded Mica Condensers, popular values £2 10 0
200 Assorted Silver Mica Condensers, popular values £2 10 0
200 Assorted Carbon Resistors, ½, ¼ and 1 watt. Good selection £1 10 0

PAXOLIN SHEET. 18 x 4½ x 1/16in. 1/6; 10 x 10 x 1/16in. 1/6; 20 x 20 x 1/16in. 3/-; 10 x 10 x 1/8in. 2/-; 20 x 10 x 1/8in. 4/-; Minimum P. & Pkg. 1/6.

T.V. TUBES. A limited quantity of 9in. and 12in. Magnetic T.V. Tubes, brand new and boxed, by famous maker. Specification: 12in. will replace most MAZDA 12in., 2 v. tubes. Flat face, white fluorescence triode 1.5 a. heater current, anode voltage 10 kV. £8/19/6 including mask. 9in. Tube, round face, white fluorescence, 4 v. lamp heater, max. anode volts 7 kV. Price £5/17/6. Both items plus 11/6 carr. & Pkg.

W.W. RESISTORS. 5 watt 1/6; 10 watt 2/6; 15 watt 3/-; 20 watt 3/6. We carry stocks of resistors from 2 watts to 150 watts W.W. Your enquiries invited.
HIGH STABILITY RESISTORS. ½ watt 5% 6d.; ¼ watt 5% 9d.; 1 watt 5% 1/-. A few values in 1% and 2% still available.
ALL ORDERS FOR RESISTORS C.O.D. PLEASE, AS WE CANNOT GUARANTEE TO STOCK ALL VALUES.
GROMMETS. 1 gross assorted ⅛in. to 1in. 8/6
WESTECTORS. WX6, WX12, W4, 1/- each ..... per doz. 9/-
SIGNAL LAMP HOLDERS. Panel mounting, complete with Adjustable Lamp Holder 2/- each ..... per doz. 21/-
FUSEHOLDERS. B/Lee L.356 single hole 2/6 each; B/Lee L.1033/C4 double pole 3/6 each. SPECIAL PRICES FOR BULK QUANTITIES.

A GIFT FOR THE SERVICE MAN. Brand new in wooden case. The Weston Model 772 Type 6 super sensitive analyser.
This precision designed multi-range test instrument has a large visible finely divided scale giving some of the range shown.
Range: **D.C. volts** 20,000 ohms per volt or 1,000 per volt. 2.5 volt range 50,000 ohms. 10 volt range 200,000 ohms. 50 volt range 1 megohm, 250 volt range 5 megohms. 1,000 volt range 20 megohms. **Ohms:** 0-3,000 ohms. 0-30,000 ohms. 0-3 meg. 0-30 meg. **D.C. milliamps:** 10, 50, 250, 1M/A 100 micro amps. or 50 micro amps. **A.C. Volts:** 1,000 ohms per volt. Price £12/10/-. Post & Pkg. 7/6.

WEARITE COILS. PA4, PO4, PA5, PO5. 1/3 each ..... per doz. 12/-
4-WAY PUSH-BUTTON UNITS. 2/6 each. Knobs for same, 3d. each.
POINTER KNOBS. Small black with white line, 7/6 per doz. Small white with black line 8/- per doz. Both types ¼in. spindle. Large price reductions for 1,000 lots and over.
VALVE HOLDERS. Moulded B9A 7/6; B7G 6/-; Int. Oct. 9/-; Eng. Oct. 4/6. Valve-holders fitted with lower can 1/6 per doz. extra.
SCREENING CANS for B7G and B9A 6/- per doz.

CO-AXIAL PLUGS, SOCKETS AND CONNECTORS. PYE TYPE. 10H/3911, 1/6 each; 10H/701, 1/6; 10H/628, 1/6; "Tee" con. 2/-; F. & E. Type: JS-1-PF 2/- each; JP-1-250 c.c.t. 2/-; JS-1-BHF, 4/6; PL259 DE, 4/6. LARGE QUANTITIES AVAILABLE. SPECIAL PRICES FOR 100 and 1,000 lots.

JONES PLUGS AND SOCKETS. 4 pin 2/6 pair; 6 pin 3/6 per pair; 8 pin 4/6 per pair; 12 pin 6/6 per pair. If cover required send 1/6 extra per cover.
WANDER PLUGS. Red and black ..... doz. 2/-
PHILIPS TRIMMER TOOLS 1/- each ..... doz. 10/6

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One minute from Tottenham Court Road Station

1 K.W. HIGH-GRADE AUTO-TRANSFORMERS. 220/110 v. Completely shrouded. Size 7½ x 5 x 7in. Weight 36lb. £5/17/6. P/P. 10/-.
D.C. RECTIFIER UNITS. Type 13, Input 200/250 v. A.C. 50 C.P.S. Output 12/24 v. D.C. 3 amps. Continuous rating, fitted in metal case 10 x 6 x 7in. with fuses, switch. Ideal for relay work, telephones, etc. £4/17/6 each.
NEW ADMIRALTY PATT 57340 TORQUE TRANSCEIVERS. Weatherproof, 20 lb. in. 230 v. A.C. 50 cycles, weight 26 lbs. each. £15 per pair.
AIR TEMPERATURE GAUGES, ref. No. 6A/510, fitted Mercury in Steel Capillary Tube. Transmitting type. Reading -30/0/50 +, Centigrade. Suitable for greenhouses, etc. 18/6.
CAPILLARY RADIATOR THERMOMETERS, with 20ft./50ft. length of capillary tube, ref. 6A/1313, sealed 40/140° C. 27/6.
ROTARY VARIABLE RHEOSTATS, 300 ohm. 250/300 watts, overall size 3¼in. x 4¼in. x 4in., on twin former with 1¼in. spindle, ¼in. diam., new boxed 27/6.
SLIDING RESISTANCES, enclosed type, 20 ohms, 2.3 amps., 17/6.
NEW "BURGESS" UNIVERSAL METAL CASED MICRO-SWITCHES. Ref. 5C/4099. 40/- per doz. £15 per 100.
"HYMATIC" COMPRESSORS. Ex R.A.F. gives 45 lb. sq. inch when coupled to ¼ h.p. motor. Fitted spline shaft. Ideal for paint spraying, etc. 47/6 each.
NEW "KLAXON" SYNCHRONOUS CAPACITOR INDUCTION MOTORS. 230/240 volts A.C. 50 cycles, 1/40th h.p., 1,500 r.p.m., mounted in metal frame, 9in. long, 4in. wide 4¼in. high diameter of motor 3¼in. length 6in. with 1¼in. long spindle diam. ¼in. complete with capacitator, fan cooled. £3/17/6.
SOLENOID OPERATED 24-VOLT D.C. CONTACTORS, by Watford Electric Co. Ltd., double pole contacts to carry 25 amps. 200 volts A.C., fitted on Bakelite panel, ¼in. thick, 8in. square, new in maker's cartons. 37/6 each.
"VENNER" SYNCHRONOUS CLOCK MOTORS. 200/250 v. A.C., 2 watts, final speed 30 r.p.m. 16/6.
CLOCKWORK DRIVEN PRECISION TIMERS, variable 5 mins. to 30 mins., 5-amp. make or break contacts, totally enclosed, 3in. diam., 2¾in. high. 18/6.
HORSTMAN GEAR CO. 8-DAY NINE-JEWEL LEVER MASTER CLOCKWORK MOVEMENTS. Admiralty pattern A.2236, final speed 1 rev. in 3 mins. with contacting point once per minute, in metal case 5¼in. diam., 2¼in. deep, stop and start device, with winding key, new 55/-.
WESTERN ELECTRIC BLOWER MOTORS. Fitted centrifugal fan, available 12 volts D.C. or 110 volts A.C./D.C. Suitable for car heaters, projectors or miniature vacuum cleaners, etc. Size 4¼in. x 3¼in. approx. Price 29/- each.
NEW SEWING MACHINE MOTORS. 100/130 volts A.C./D.C. 1/15th h.p. Fitted pulley, adjustable fixing bracket, needle light lamp with switch, rubber driving belts, connecting lead, etc. Less foot control. 37/6 each.
PRESSURE PUMP UNITS. Operated by 24 volt A.C./D.C. motor develops 10 lb. pressure or vacuum. Complete with 10ft. length of pressure hose, cables and connectors, etc. Compact unit fitted in metal case, 6in. x 4in. x 4in. Made in U.S.A. Ideal for laboratory use, etc. New, in maker's cartons. £4 each.
MOTOR-DRIVEN SELF-PRIMING PUMPS, ref. 5UE/6261, 24 volts, 2 amps, giving 7 g.p.h. at 15 lb. sq. in., will give proportionately less as 12 volts, overall length 9in. x 2in. wide approx., ideal for pumping water or oil, etc. 30/- each.
FRACTIONAL H.P. MOTORS, 1/100th h.p., 200/250 volts D.C./A.C., length 3¼in., diam. 2¼in., double-ended spindle ¼in. thick, unused. 27/6.
SOLENOID OPERATED OIL DILUTION VALVES, ref. 5U/3013, 24 volts, suitable for air or oil, maximum air pressure 40 lb. p.s.i., overall size 3¼in. long, 1¼in. diam. approx. 7/6.
Ditto, 12-volt, ref. 5U/1566 9/-. Special quotation for quantities.
CONTACTING FLOAT SWITCHES. Ref. 5CW/4648, comprising of float in wire mesh container, 3in. diam. 4¼in. long, operating make or break sealed contact. Ideal for automatic bilge pump control and non-corrosive liquids, etc. 15/- each.

S.T.C. METAL RECTIFIER SETS. Input 200/250 volts A.C., 50 cycle output, 220 volts D.C., 1½ amps., type 10D/1786, housed in metal cabinet, 12 x 13 x 11in. unused. (Carriage paid) £10/10/- each.
SOLENOID OPERATED MAGNETIC RELAY. Type "S" ref. 5CW/3544, with 4 make 4 break 10 amp. contacts D.C., coil resistance 160 ohms, 24 volts operation, housed in metal screening can 2¼ x 1 x 1¼in. Made by Pullin Ltd., Hendry Relays Ltd., etc. 8/6 each.
"VENNER" CLOCKWORK DELAY TIME SWITCHES. Variable 10 to 30 secs. Fitted 250 volt A.C. 5 amp. or 24 volt D.C. 5 amp. contacts make or break, panel mounting size 2in. diam., 2¾in. long, new. 14/- each.
U.S.A. DYNAMOTORS, UNUSED. Input 12 v. D.C. Output 225 v. D.C. 100 m/a., 35/-.
Input 28 v. D.C. Output 250 v. D.C. 60 m/a., with filter, 17/6.
Input 28 v. D.C. Output 230 v. D.C. 100 m/a., 18/6.
Input 28 v. D.C. Output 330 v. D.C. 170 m.a., with filter, 25/-.
Input 26/28 v. D.C. Output 540 v. D.C. 450 m/a., 37/6.
U.S.A. SPERRY BOMBSIGHT COMPUTERS, unused ex-R.A.F. contains hundreds of components, gears, motors, etc. Total weight 78 lb. Ideal for model makers, experimenters, etc. 80/- each.
NEW G45B GUN CAMERAS, for 16 mm. work, fitted with 2in. f/3.5 lens, cassette taking 25 feet of film, gearing and gate mechanism for 24 volt D.C. operation, can be used as a cine camera by slight modification, unused. £6/15/-.
TYPE F60, AIRCRAFT CAMERA, originally designed to photograph cockpit dials, uses 35 mm. film, fitted 1½in. f/1.9 lens, hand or electrical wind, no shutter or iris diaphragm, will take single shots half-Leica size pictures, ideal for modification, new, in maker's cartons, £5 each.
AIR-POSITION INDICATORS, fitted with approx. 12 lb. of useful parts, including 3 sets of infinitely variable speed gearboxes, two 27 volt D.C. 1.5 a. motors with pulley shafts. £3/12/6 each.
VISUAL INDICATORS TYPE 10/04. contain 2 high-grade movements, 1 horizontal, scale centre zero to 30 microamps f.s.d., vertical movement 0/750 microamps f.s.d., 7/6 each.
NEW NEGRETTI AND ZAMBRA 200/250 volt A.C. operated control units, fitted step-down transformer to rectifier giving 12 volts D.C. which operates two relay operated single pole change-over 10 amp. mercury switches, housed in metal cabinet, 9¼ x 8¼ x 3in. 55/- each.
"LIMIT" ELECTRICAL CAPACITOR INDUCTION MOTORS. 220/240 v. A.C. 50 cycles. Silent running, intermittent rating, thermostatic control. 4in. diam. 3¼in. deep with 1 in. diam. coupling. 37/6 each.
"BERCO" SLIDING RHEOSTATS Twin, former 28 ohm, 6½ amps., length 14in., width 7in. Ideal for stage dimming, charging, etc. 46/6 each.
9/12 VOLT A.C./D.C. MOTORS. U.S.A. coupled to gear-box, final speed approximately 100 r.p.m., ¼in. diam. spindle., overall size 3¼in. x 2in. x 1¾in., 15/-.
STEP-DOWN TRANSFORMERS, input 180/230 v., A.C., 50 cycles, output 2 windings 4.2, 4.2 v., 10 amps., ideal coil heating, spot welding, 22/6.
HEAVY DUTY L.T. TRANSFORMERS, Pri. 230 volts sec. 50 v. 50 amps. adjustable by voltage regulator sted switch on primary both in steel case with meter reading 0-100 volts, mains switch and O.P. sockets, will stand 100% overload, supplied brand new, size of case 18in. x 12in. x 16in., approx. weight 100lbs. £15/10/- carr. paid.
T.R.S. 3-CORE NON-KINK ENAMELLED CABLE, 250 volts, 20 amps., 36/.013 in 50-yard coils. £4/7/6 per coil.
TRAILER CABLE, NON-KINK V.I.R., twin 78/.018, 50/60 amps., in 100-yard coils, fitted with Nipham sockets. Per 100 yards. £17/5/-.
HYDRAULIC PUMPS. Ref. IHC/mark IA, suitable for water or oil, flanged mounting spline shaft, new 47/6 each.

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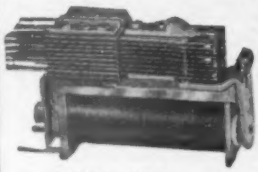


MINIATURE RELAYS

Siemens High Speed. Sealed.
2.2Ω + 2.2Ω 1 C O H06A **17/6**
1700Ω + 1700Ω 1 C O H06E **25/-**

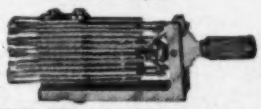
S.T.C. Sealed
700Ω 1 make HD 4186ED **19/6**
700Ω 2 Change over 4184GD **19/6**
2700Ω 2 Change over 4184GE **22/6**

G.E.C. Sealed
2Ω 2 make SM5H1 **19/6**
180Ω 2 make 2 B. SM5H9 **22/6**
670Ω 2 make 2 B. SM5H12 **25/-**
2500Ω 1 C. O. SM5N18 **25/-**

T.M.C. Carpenter Relays
330Ω + 1040Ω 4B21 **75/-**
850Ω + 2680Ω 5M32A **45/-**
300Ω + 700Ω 5XA24 **45/-**
All available from stock.

KEY SWITCHES

PROMPT DELIVERY ALL TYPES UP TO 4co/6co



HIGH GRADE INSTRUMENTS FOR RESEARCH LABS, SCHOOLS, etc.

RADIO-ACTIVITY MEASURING INSTRUMENTS. Philips Type 1092B. A portable self-contained unit in haversack. Scaled 0 to 10 millirontgens per hour, using Mullard Geiger Counter MX115, **£24.**
TEST SET Reading Absolute Volts and Amps. D.C., by Elliott Bros. First Grade, B.S.80. 5in. Mirror scale with 150 divisions. 6 ranges of volts, 0/075 to 0/750. 4 ranges of Amps. 0/1.5 to 0/600. Brand new, complete with all shunts and leads..... **£35**
AMMETERS 0/3 Moving Coil D.C., 6in. Flush Round with a fine open scale with divisions of 50 MA, B.S.S. 89..... **90/-**
VOLTMETERS, 0/300 Moving Iron, A.C., 6in. Flush Round..... **110/-**
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500 "	2½in.	MC/FR	37/6
1 Milliamp	2in.	MC/FR	27/6
1 "	2½in.	MC/FR	35/-
5 "	2in.	MC/FR	17/6
30 "	2½in.	MC/FR	12/6
100 "	2½in.	MC/FR	12/6
200 "	2½in.	MC/FR	12/6
250 "	2½in.	MC/FR	12/6
5 Amperes	2in.	MC/FR	27/6
15 "	2in.	MC/FR	10/6
25 "	2½in.	MI/FR	7/6
50-0-50 Amp.	2in.	MC/FR	12/6
30-0-30 "	2in.	MC/FR	15/6
20 Volts	2in.	MC/FR	10/6
40 "	2in.	MC/FR	10/6

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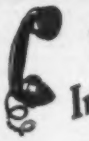

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Taylor valve tester type 45	£12	0	0
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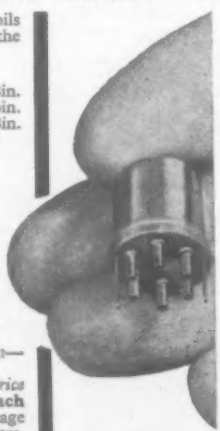

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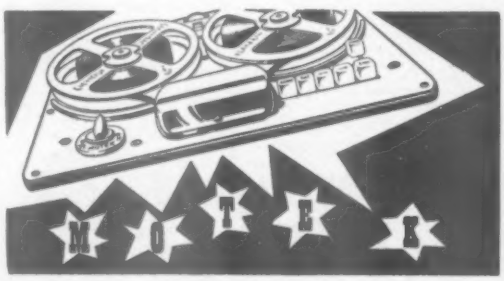

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Adjustable every 6in. to approx. 9ft. 6in. when fully extended. (Folds up to only 4ft. 6in. for storage.) Suitable for outdoor speakers, public address systems, floodlighting, etc., etc.

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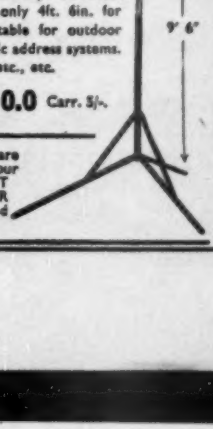
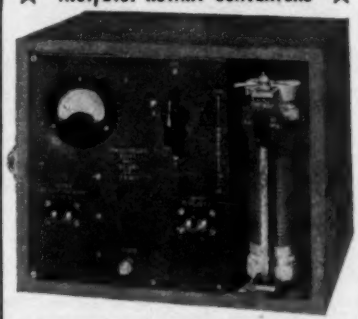


These stands are ideal for our RE-ENTRANT LOUD HAILER as described above.

★ A.C./D.C. ROTARY CONVERTERS ★



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WESTALITE TRANSFORMER RECTIFIER. Oil filled. Primary 380-440 v. 50 cycles, 3 phase. Supplying 20 v. D.C. at 200 amps. Complete with original control panel. Perfect condition, unused. £200 ex-stores.

ACCUMULATORS, Bakelite-cased. 2 v. 100 A.H., 75 actual. Ex-Govt. New and unused. Complete with carrying handle. Size 6½ x 6½ x 3½in. 15/- each. Carr. 3/6. 3 sent for 50/-, or 6 for £3, carr. paid. Ditto 16 A.H., 5/-. P. & P. 2/-. Ditto, 14 A.H. less handle, 5/-. P. & P. 2/-.

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E.H.T. TRANSFORMER. 9,500-0-9,500 at 2.9 kVA. Pri. 230 v., 50/60 cycles. New and unused. £25. Carr. paid.

E.H.T. TRANSFORMERS. 3,850 v. at 50 mA. with two additional 4 v. L.T. windings for 230 v. 50 cycles primary. New and boxed, £3/15/-. Carr. 5/-.

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SG50 SIGNAL GENERATOR covers 100 kc/s to 80 Mc/s in six ranges on fundamentals. A de luxe instrument for only £9. A few only, brand new but slightly soiled cases for £8. Carr./packing 6/- extra.

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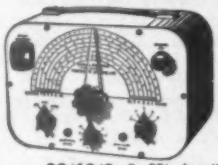
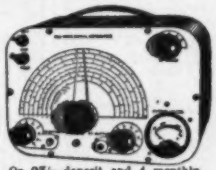
SIGNAL GENERATOR



Coverage 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. × 6¼in. × 5¼in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F., output continuously variable 100 millivolts, C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£6/19/6 Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

SIGNAL GENERATOR



Coverage 120 Kc/s.—230 Kc/s., 200 Kc/s.—900 Kc/s., 900 Kc/s.—2.75 Mc/s., 2.75 Mc/s.—8.5 Mc/s., 8 Mc/s.—28 Mc/s., 16 Mc/s.—56 Mc/s., 24 Mc/s.—64 Mc/s. Metal case 10in. × 6¼in. × 4¼in. Size of scale, 6¼in. × 3¼in. 2 valves and rectifier A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F., output continuously variable 100 millivolts, C.W. and mod-switch, variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%.

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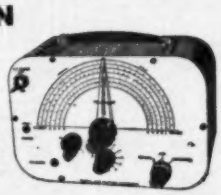

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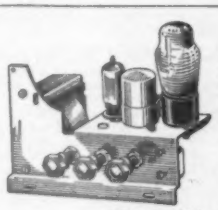
Coverage 7.6 Mc/s.-210 Mc/s. in five bands, all on fundamentals, slow motion tuning audio output, 8 vertical and horizontal bars, log-ging scale. In grey hammer finished case with carrying handle. Accuracy ±1%. A.C. mains 200-250 v.

PORTABLE AMPLIFIER



Size 4¼in. long, 5in. high, 2¼in. deep. Will suit any type of crystal pick-up. Output approx. 2 watts. Incorporating ECC83 double triode. Cosmor 142BT output pentode and contact-cooled rectifier. Fully isolated mains transformer for 230-250 A.C. mains. Bass, treble and volume controls.

49/6 Plus P. & P. 2/6

5' SPEAKER WITH O.P. TRANSFORMER

purchased with the above **18/6**. Plus P. & P. 1/6.

B.S.R. MONARCH UA8.

4-speed, plays 10 records 12in., 10in. or 7in. at 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 13½ × 10¼in. Space required above baseboard 4¼in., below baseboard 3¼in. Fitted with Full-Fi turnover crystal head.

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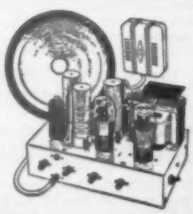
8 WATT AMPLIFIER

PUSH-PULL

COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER



A.C. mains 110/250 v. Size 10¼in. × 6¼in. × 2¼in. Incorporating 6 valves, H.F. pen., 2 triodes, 2 output pens., and rectifier. For use with all makes and types of pick-up and mike. Negative feed back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. For use with 8in. or L.P. records, musical instruments such as Guitars, etc.

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Finished in 2 tone leatherette, will take B.S.R. UA8, with room for amplifier and 7 × 4 speaker. Overall size 15½in. × 13½in. × 9½in.

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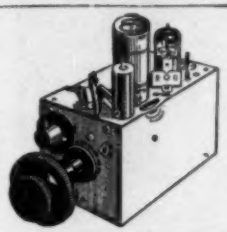
Model 457. Type "O" Pick-up, size 13in. × 13½in. Minimum clearance above baseboard 3in., below 2½in., 10 records. A.C. mains 200-250 v. Turnover crystal head. BRAND NEW. Fully guaranteed. 25/- deposit plus P. & P. 5/- and 7 monthly payments of 25/-. Cash **£8/19/6** Plus P. & P. 5/-

13 CHANNEL TUNER



I.F. 11-16 Mc/s. or 24 to 38 Mc/s. complete with PCF80 and PCC84. These have been removed from chassis. State frequency required.

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Knobs 3/6 per set extra.

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Comprising 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milliamps, 0-10, 0-100. Ohms range, 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistors and rectifier. Basic movement, 2 mA. In grey hammer finish case.

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5 valve, A.C./D.C., 3 wave-band superhet, 190-256 v., 19-49, 200-550 and 1,000-2,000 metres, I.F. 470 Kc/s., size of chassis 13in. × 6¼in. × 2¼in. Valve line-up: 10C1, 10F9, 10LD11, U404 and 10P14. Twin mains filter input, 3 dial lights and 8in. P.M.

£6/19/6

P. & P. 5/-

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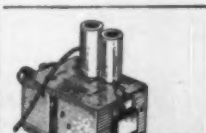

Covers all Channels, Bands 1 and 3. Valves used: PCC84, R.F. double triode, cascode R.F. amplifier, PCF80, triode pentode L.o. and mixer, I.F. output 33-38 Mc/s. Easily modified to other I.F. outputs. Full instructions. Complete with 12 Coil Sets.

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39/6 Plus 3/6 postage & packing.

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Approx. output 2 watts, negative feed back, tone and volume controls. All the parts to make above less chassis speaker and O.P transformer. Two of these would be suitable for stereophonic. 19/6. Plus P. & P. 3/-.

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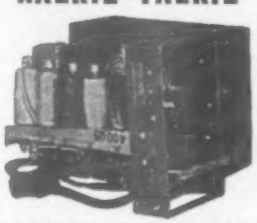
WALKIE-TALKIE



Complete in Metal Carrying Case. 9in. x 6½in. x 4in. Weight 6lb. Frequency 7.3 to 9 Mc/s. Five valves. £1/2/6. Post paid.

These Tx-Rs are in NEW CONDITION, but owing to demand they are not tested by us and carry no guarantee, but should prove SERVICEABLE.

ATTACHMENTS for Type "38" Transreceivers. ALL BRAND NEW: Headphones 15/6; Throat Microphones 4/6; Junction Boxes 2/6; Aerials, No. 1 2/6; No. 2 5/-; Webbing 4/-; Haversacks, 5/-; Valves—A.R.P.12 4/6; A.T.P.4 3/6; Set of FIVE VALVES 19/- the set.

OFFER No. 2:

"38" as above, complete with set of external attachments, 42/6, post paid.

OFFER No. 3:

Transmitter-Receiver "38" Mk. II. Brand new with complete set of external attachments including Webbing Haversacks and Valves, 57/6, post paid. Fully guaranteed.

TRANSRECEIVERS. Type "18" Mark III. Two Units (Receiver and Sender). Six valves, Micro-ammeter, etc., in Metal Case, untested, without guarantee but COMPLETE, £2/18/6.

ATTACHMENTS for "18" Transreceivers. ALL BRAND NEW. Headphones 15/6; Hand Microphone 12/6; Aerials 5/-; Set of 6 Valves 30/-.

T1154 TRANSMITTERS. Complete in transit case. New condition. £2/5/-.

RECORDING BLANKS. Brand new. "Emidisc." Ready for cutting. 13in. 4/- each or 15 complete in metal case £4.

RESISTANCES. 100 assorted useful values. New wire end 12/6. NEW.

CONDENSERS. 100 assorted Mica; Tubular, etc., 15/-. NEW.

LUFBRA HOLE CUTTERS. Adjustable ⅜in. to 3½in. For Metal Plastics, etc., 7/-.

QUARTZ CRYSTALS. Types F.T.241 and F.T.243. 2-pin, ⅓in. spacing. Frequencies between 5,675 kc/s and 8,650 kc/s (F.T.243). 20 Mc/s and 38.8 Mc/s (F.T.241, 54th Harmonic) 4/- each. ALL BRAND NEW, TWELVE ASSORTED CRYSTALS, 45/-. Holders for both types 1/- each. Customers ordering 12 crystals can be supplied with lists of frequencies available for their choice.

TRANSPARENT MAP CASES. Plastic. 14in. x 10½in. Ideal for Maps, Display, etc., 5/6.

STAR IDENTIFIERS. Type 1 A-N Covers both Hemispheres. 5/6.

CONTACTOR TIME SWITCHES. 2 impulses per sec., in case, 11/6.

REMOTE CONTACTOR. For use with above. 7/6.

MORSE TAPPERS. Midget type, 2/9; Standard, 3/6; Heavy type on base, 5/6. ALL BRAND NEW.

MORSE PRACTICE SET. TAPPER with BUZZER on base. Complete with battery, 12/6, BRAND NEW.

MAGNETS. Strong Bar type. 2 x ⅓in., 1/6 each.

PACKARD-BELL AMPLIFIERS. Complete, BRAND NEW, with valves, relay, etc., etc., 17/6 each.

SPECIAL OFFER. 12 ASSORTED METERS. Slightly damaged. Mainly broken cases (perfect movements). Including 3 BRAND NEW Aircraft Instruments. 12 for 45/-.

Post or carr. extra. Full list Radio Books, etc., 3d.

SOUTHERN RADIO SUPPLY, LTD.

11, LITTLE NEWPORT STREET, LONDON, W.C.2. GERrard 6653.

RADIO CLEARANCE LTD.

TRADE ENQUIRIES INVITED

27, TOTTENHAM COURT RD., LONDON, W.1.

The oldest Component Specialists in the trade

Telephone: MUSEUM 9188 EST. 30 YRS

ELECTROLYTIC CONDENSERS—WE HOLD THE LARGEST STOCK OF ELECTROLYTICS IN ENGLAND

ABBREVIATIONS: C. Clip mounting tag ends. P. Prong mounting. T. Tag ended. S. Sleeved. W. Wire ended.

SINGLES

Capacity (Mfds.)	Wkg. Volts	Size"	Type	Price
1	275	½×1½	W/S	1/-
2	200	½×1½	W	1/-
2	50	½×1½	W	1/-
4	150	½×1½	T/S	10d.
4	150	½×1½	W	1/-
8	150	½×1½	W	1/-
8	150	½×1½	T	9d.
8	450	1½×2½	C	2/-
8	450	½×1½	W/S	1/11
10	25	½×1½	W	1/-
10	15	½×1½	W/S	1/6
16	450	½×2	W/S	1/9
16	150	½×1½	T/S	1/-
16	275	½×2	T	1/3
16	250	½×2	P	1/6
16	350	½×2	T	1/9
16	375	1½×4½	C	2/-
18	450	1×2	C	2/-
20	150	½×1	T/W	1/-
20	450	1×2	W/S	2/-
20	450	1×2	T/S	2/-
25	25	½×1½	T/S	10d.
25	25	½×1½	W/S	1/-
25	50	½×1½	W/S	1/-
25	350	½×1½	W	2/-
32	275	1×2	C	1/9
32	275	1×2	P	1/6
32	350	1×2	T/S	2/-
40	150	½×2	W/S	1/-
40	350	1×2	P	2/-
40	450	1×3	W/S	2/6
50	25	½×1½	T	1/3
50	50	½×1½	T	1/3
50	50	½×1½	W/S	1/6
50	150	½×2	W/S	1/-
50	350	1×2	W/S	2/3
60	275	1×3	W	2/-
80	350	1½×2	T/S	2/6
84	275	1×3	P	2/6
84	350	1×3	C	2/-
75 (Rev)	12	1×3	C	10d.
75	12	½×1½	T	1/-
80	450	1½×3	W/S	2/6
100	12	½×1½	W/S	1/-
100	25	½×1½	T	1/-
100	25	½×1½	T/S	1/3
100	25	½×1½	W/S	10d.
100	270	1½×2	C	2/3
100	275	1×3	C	2/9
100	275	1½×2	C/S	2/6
100	275	1½×3	C	2/6
100	275	1×3	P/S	2/6
100	300	1×3	P	2/6
150	25	1×3	T	1/-
150	150	1×3	W/S	1/6
200	25	½×1½	T	10d.
200	25	1×1½	T/S	10d.
200	250	1½×3	C/S	2/-
200	275	1½×3	C	2/6
250	6	1×2	T/S	1/-
250	12	½×1½	W	1/-
250	12	½×1½	W/S	1/3
250	25	½×2	C	1/-
250	25	½×1½	C	1/3
250	25	½×1½	W/T	1/3
250	25	½×1½	W/S	1/3
250	50	1×2	C	1/6
250	150	1½×3	P	1/3
250	275	1½×2	T	1/6
250 (Rev)	6	1×3	P	1/-
300	6	½×1½	T	10d.
300	6	1×2	C	10d.
300	12	½×1½	T	1/-
300	12	1×2	T	1/-
300	25	1×2	C	1/3
300	150	1×2	C	1/6
300	275	1×3	C	2/-
300	275	1½×3	C	2/6
350	12	1×2	T	1/-
350	25	1×2	C	1/3
350	150	1×2	C	1/6
350	275	1×3	C	2/-
350	275	1½×3	C	2/6
350	275	1×3	P	2/-
350	275	1½×3	P	2/6
400	12	1×2	C	1/-
400	25	1×2	C	1/3
400	150	1×2	C	1/6
400	275	1×3	C	2/-
400	275	1½×3	C	2/6
400	275	1×3	P	2/-
400	275	1½×3	P	2/6
450	12	1×2	C	1/-
450	25	1×2	C	1/3
450	150	1×2	C	1/6
450	275	1×3	C	2/-
450	275	1½×3	C	2/6
450	275	1×3	P	2/-
450	275	1½×3	P	2/6
500	12	1×2	T	10d.
500	25	1×2	C	1/3
500	100	2½×4½	C/S	1/6
1000	25	1×2	C	1/6
5000	25	1½×4½	C	4/-

DOUBLES

8+	8	350	1×2	T	2/6
8+	8	450	½×1½	W/S	2/-
8+	8	450	1×2	W/S	2/9
8+	16	450	1×1½	W/S	2/6
10+	10	450	1×2	W/S	2/6
16+	16	350	1×2	C	2/-
20+	10	450	1×3	C	3/-
20+	20	150	1×2	W/S	1/-
20+	20	450	1×2	W/S	2/9
24+	24	350	1½×2	C	3/-
25+	25	300	1×2	T	2/-
30+	30	150	½×1½	W/S	1/-
32+	16	300	1×2	P	1/6
32+	16	350	1½×2	T	2/6
32+	16	350	1×2	T	2/6
32+	32	275	1½×2	C	2/9
32+	32	350	1½×2	C/S	4/-
32+	32	450	1½×3	W/S	4/6
32+	32/m	350	1½×1	T	3/-
32+	32	150	1×2	T	2/-
40+	40	150	1×3	P	1/-
40+	40	150	1×2	W/S	1/-
40+	40	275	1½×2	C/S	2/9
40+	40	450	1½×3	W/S	3/-
50+	50	150	1×2	W/S	1/-
50+	50	25	1×3	C	1/6
50+	50	150	1×2	W/S	1/6
50+	50	275	1½×3	P	2/9
50+	50	275	1½×3	C	2/9
50+	50	275	1½×2	T	2/-
50+	50	350	1½×2	T	2/6
50+	50	350	1½×3	C	3/-
50+	50	350	1½×3	P	3/-
50+	50	450	1½×3	W/S	3/6
50+	50	450	1×2	W/S	3/-
50+	50	450	1×3	C	3/6
50+	50	450	1×3	P	3/6
60+	60	350	1×2	T	2/6
60+	60	450	1×2	W/S	3/-
60+	60	450	1×3	C	3/6
60+	60	450	1×3	P	3/6
80+	80	350	1×2	T	3/6
80+	80	450	1×2	W/S	3/9
80+	80	450	1×3	C	4/-
80+	80	450	1×3	P	4/-
100+	100	12	1×2	P	1/6
100+	100	275	1½×3	C	3/6
100+	200	25	1×2	IP	1/-
100+	200	250	1½×4½	C	4/6
100+	200	275	1½×4½	C	5/6
100+	200	275	1½×4½	C	5/-
100+	200	275	1×4½	C	4/6
100+	400	275	2×4½	C	4/6

TRIPLES Etc.

6+8+8	350	1×2	P	4/6
16+8+4	275	1×2	P	3/-
16+16+16	275	1×2	C	3/6
25+25+25	25	1×2	C/S	1/6
32+8+8	275	1×2	P	3/-
32+32+8	275	1½×2	C	3/6
32+32+8	275	1×3	P/C	3/-
32+32+8	350	1½×3	C	5/6
32+32+32	275/275	1×3	T	3/9
40+20+10	350	1×3	P	3/6
40+20+20	275	1×3	P	3/6
40+40+20	275	1×3	P	3/-
50+50+10	150	1½×2	T	1/-
50+50+50	350	1½×2	F	3/6
100+250+250	275	2×4½	C	6/-
200+250+250	275	2½×4½	C	6/6
40+20+10+10	350	1½×2	C	3/6

All voltages quoted are WORKING. STAMPED AND ADDRESSED ENVELOPE with any enquiry, please.

PLEASE ALLOW FULL POSTAGE AND PACKING CHARGES.

MINIATURE BIAS CONDENSERS

25 MFD. 25 v., 50 MFD. 12 v., 80 MFD. 25 v. ½in. × ¾in. 1/6 each.
25 MFD. 50 v. ½in. × 1¼in., 1/9.

SUB MINIATURE METALLISED PAPER CONDENSERS.

½in. × ¼in. 100 v. working
.005 MFD., .0025 MFD., .002 MFD., .001 MFD., 9d. each .01 MFD., .02 MFD. Price 9d. each .04 MFD. 10d.

DISC CERAMIC CONDENSERS 500 v. Wkg.

250 PF., .001 MFD., .0025 MFD., .002 MFD., .005 MFD., .005 MFD. 6d. each .01 MFD. 9d.

VARIABLE GANG CONDENSERS

Twing Gang. 20 pF. Ideal for F.M. 2in. × 1¼in. × 1in. 2/-.
Twin Gang. .0005 MFD. 2¼in. × 2in. × 1¼in. Spindle ¼in., 4/-.
Min. Twin Gang. .0005 MFD. 2¼in. × 1¼in. × 1¼in. Spindle ¼in. 5/6.
Min. Twin Gang. .0005 MFD. 2¼in. × 1¼in. × 1¼in. Spindle ¼in. with trimmers, 6/6.
Twin Gang. Geared with SM. 3/6.

TRANSISTOR GANG CONDENSERS

with intermediate screen as specified for MULLARD Transistor circuits, 9/6.
As above with switch for long wave pre-selection, 11/-.

SWITCHES ROTARY

Size 1½in. dia. 6in. spindles. Price 2/11 each.
1 pole 10 way. 1 pole 12 way. 2 pole 2 way. 2 pole 3 way. 2 pole 4 way. 2 pole 5 way. 2 pole 6 way. 3 pole 3 way. 3 pole 4 way. 4 pole 3 way.

SUB MINIATURE CARBON POTS

1K, 2K, 5K, 50K, 250K, 500K, 1M, 2/- each. 5M, with switch, 4/6. 5K, 1/6, 500K preset 1/-, 1M with Rect., 2/-, Transmine Pots, 1/6.

POTMETERS CARBON

Moulded Tracks. Diam., 1in., ¼in. spindles, 5K, 10K, 25K, Linear only. 50K, 100K, 250K, 500K, 1M, 2M, Log or Linear, less switch, 2/6 each. With switch, 4/6.

TV PRESET CONTROLS

Knurled knob and 6BA fixing holes. Diam. 1in. 5K, 25K, 50K, 100K, 250K, 500K, 2M, 1/3 each. 25K. wire wound 1/6.

SUB MINIATURE ELECTROLYTIC CONDENSERS—SLEEVED—All at 2/3 each.

.1 mfd. 12 v., .25 mfd. 15 v., 2-6-6-10 mfds. 3 v., 2-6-6-10 12-16-30-50 mfds. 6 v., 1 mfd. 10 v., 1 mfd. 25 mfds. 12 v., 2-8-25 mfds. 15 v., 8 mfds., 16 mfds., 30v., 2 mfds., 70 v.

WIMA TROPIDUR PAPER CONDENSERS

Small, non-inductive, insulated, high-grade capacitors 600 v. working, 680 pf., 1,000 pf., 1,500 pf., 2,200 pf., 7d. each. 3,300 pf. 8d. 5,000 pf., 6,800 pf., .01 mfd., .012 mfd., 9d. each .022 mfd., 10d. .05 mfd., 11d. .1 mfd. 1/2. .1 mfd. 250 v. 1/1. .25 mfd. 1/6. .5 mfd. 1/9.

VALVE HOLDERS

4 pin Brit. Pax. 2d. 4 pin U.K. Amp. 7d. 5 pin Brit. Pax. 2d. 7 pin Brit. Pax. 2d. 7 pin Brit. Amp. 4d. Int. Octal Pax. 3d. Mazda Octal Pax 2d. Loctals Amp. 6d. B7G Pax. 6d. B7G P.T.F.E. 9d. B7G Cer. with saddle and valve retaining spring 1/-. B9A Pax. 4d. B9A Amp. 6d. B9A Cer. 8d. B9A Pax. 6d. B9A Amp. 8d. B9A Amp. with skirt 10d. B9A Cer. 10d. B9A Cer. with saddle and valve retaining spring 1/-. B9A ceramic with skirt 1/-. B9A printed circuit 1/-. B9A Valve Cans 6d.

WIREWOUND POTS

Min. 6Ω., 1½ spindle, 2/-. 100Ω Colvern, 2/-. 500Ω Preset, 1/6. 5K Colvern, 2/6.

BLOCK CONDENSERS

.1, .25 mfd., .5 mfd., 1 mfd., 600 v. battitub, 1/6 each. 1 mfd. 100 v. 1/3. .5+.5 mfd. 400 v., 1/6. 2 mfd. 400 or 600 v., 2/6. 4 mfd. 1,000 v., 6/6. 4 mfd. 2,000 v., 8/6. 8 mfd. 1,000 v 8/6. 8 mfd. 1,500 v., 9/6.

METAL RECTIFIERS

S.E.C. 240 v. 250 ma. T.V. Price 10/-.
Westinghouse. 16 RD. 2.2.5.1. 7/-.
Westinghouse. 16 BC. 1.1.16.1. 4/6.

T.V. COMPONENTS

34 Mc/s. I.F. Transformers. Size ½×½×2½. 1/6.
38 Mc/s. I.F. Transformers. Series link. Size ½×½×2½. 2/-
Frame Output Transformers. Wide angle. 4/6.
Focus Magnets. Adjustable for 14in. tetrode, 4/6.
Line Output Transformers, Ferroxi, 21/-.
Scan Coils, wide angle, 15/-.

MISCELLANEOUS

Vibrators, Plessey 6 SR78DT Sync. 7 pin. 7/6. Bulldog Clips, 2d. Crocodile Clips, 4d. Toggle Switches, 1/-. Min. 1PT 470 kc/s. 7/6 and 8/6 pair. Ion Traps, 1/6. Coax Plugs and Sockets, 2/2 pair. Thin screened Pick-up Wire, 1/- yd. Min. Mains Transformer, tapped, auto Pri. 130/170 v., 20 ma. Sec., 4/6. Min. Mains Transformer, tapped Pri. 220 v. 35 ma., Sec. with 16 v. .5 amp., 8/11. Bayonet Pilot Lamp, 6 and 12 v., 6d. each. T.V. Panels with 6 pre-set controls, 5/6. Condenser Clips, 1in. and 1¼in., 6d. each. Parmeko Smoothing Choke, 6/9 Hy 100 ma., 5/6. Tarmo-couple Motors, 350 ma., 2/6. 500 pf., 15 Kv., 2/6. 1,000 pf., 20 Kv. Visconol, 5/6. Sprague .01 mfd., 1,000 v. 6d.

FOR CALLERS ONLY

FERRITE RODS

3in. × ½in. 10d. 3in. × ¾in. 1/3. 4in. × ½in., 10d. 4in. × ¾in., 1/-. 6in. × ½in., 1/3. 6in. × ¾in., 1/6. 8in. × ½in., 1/-. 8in. × ¾in., 1/6. 6in. × ¾in., 1/6. 8in. × ¾in., 1/6. 8in. × ¾in., 1/-. 5in. × ½in., 1/-. 8in. × ½in. oval 2/-. 8in. × ¾in. × ¼in., 2/-. T.V. Masks, 14in. Tube, 2/-.
P.M. Speakers. 5in. 3 ohm., 15/-.
Elliptical Speakers, 7in × 4in., 12/6.
M.W. Frame Aerials on alloy plate, 1/6.

WIRE WOUND RESISTORS

5 watt size ⅜in. × 1¼in. 10d. each

7.5 Ω., 8 Ω., 10 Ω., 12 Ω., 27 Ω., 29 Ω., 33 Ω., 34 Ω., 36 Ω., 42 Ω., 47 Ω., 50 Ω., 54 Ω., 55 Ω., 56 Ω., 60 Ω., 66 Ω., 67 Ω., 68 Ω., 75 Ω., 80 Ω., 82 Ω., 110 Ω., 170 Ω., 180 Ω., 200 Ω., 230 Ω., 330 Ω., 470 Ω., 500 Ω., 560 Ω., 600 Ω., 620 Ω., 660 Ω., 820 Ω., 940 Ω., 1.1 K., 1.3 K., 1.4 K., 1.6. K., 1.7. K., 1.8. K., 2 K., 2.2. K., 2.4 K., 2.5 K., 2.7. K., 3.3 K 4.5 K., 4.7. K., 5 K., 5.3 K., 5.6. K., 5.9. K., 6 K., 6.2 K., 6.5. K., 6.8. K., 7 K., 8.5 K.

6 watt size. ½in. × 1¼in. 1/- each.

47 Ω., 100 Ω., 300 Ω., 330 Ω., 470 Ω., 500 Ω., 560 Ω., 600 Ω., 1 K., 1.9 K., 2 K., 2.7 K., 3 K., 4.3 K., 4.7 K., 5.1 K., 5.6 K., 6.2 K., 6.4 K., 6.8 K., 11 K., 13 K.

7 watt size. ⅝in. × 1¾in. 1/- each.

10 Ω., 12 Ω., 33 Ω., 46 Ω., 50 Ω., 56 Ω., 57 Ω., 60 Ω., 120 Ω., 470 Ω., 600 Ω., 620 Ω., 660 Ω., 800 Ω., 920 Ω., 1.6 K., 1.8 K., 2.2K., 2.7 K., 3.3 K., 4.3 K., 4.7 K., 6 K., 7 K., 11 K., 12.5 K., 13 K., 14 K., 17 K.

SPECIAL OFFERS

50 Assorted wax tubular Condensers—guaranteed 6/-
100 assorted Erie ½-1 watt resistors 12/6
1 gross packets BA Nuts and Bolts ..... 2/6 pkt.

We have a large selection of Transformers, Droppers, Silver Micas, Trimmers, Ceramics, Waxed Paper Condensers, Min. Mica Condensers, Chokes, Metallised Tubular Condensers, Hi-Stab Resistors and Transistor Components far too numerous to advertise. Why not pay us a visit when next in town? **TERMS OF BUSINESS: CASH WITH ORDER OR C.O.D. ON ORDERS OVER 10/-.**

WORLD FAMOUS

TELEPHONES F—Type

IN ATTRACTIVE CASE

The best portable telephone ever made. With a range of up to 5miles,is ideal for FACTORIES, BUILDING SITES, FARMS, CIVIL ENGINEERING PROJECTS, OUTSIDE BROADCAST UNITS AND OFFICES.

2 perfect sets **in individual carrying cases, complete with long life batteries, bells, ringer and 100ft. telephone cable.**

£7.10.0 per pair Carr. (G.B.) 9/6

DON Mk. V TELEPHONES

Few remaining, complete with 100ft. telephone cable £5/11/- per pr. Carr. (G.B.) 9/6.

D3 STRANDED TELEPHONE CABLE, NEW. Mile drum, 85/-. Carr. 17/6.

AERIAL MASTS

IMPROVED TYPE 50 MK. II

36ft. HIGH

Kits comprise—6 2½in. dia. Tubular Steel Sections of 6ft. length, top-section and base, Pickets, Guys and Fittings. YOU can purchase this normally expensive MAST for a fraction of its cost. Please add £1 for (returnable) wooden carrying case. The MAST is particularly suitable to take aerials for TV., F.M. and T.V. (especially COMMERCIAL) and has many other uses. Extra 6ft. sections can be supplied at 17/6 per section.

£8.10.0 only (Carr. 15/6).

U.S.A.-Type 45ft. TELECOM AERIAL MAST. (7 sections, 6ft. 6in. x 2½in. guys, etc.) This entirely complete set in carrying case 12½ Gns. Carr. 17/6. Or 2 sets for £25. Carr. extra. *British Manufacture only.*

ARMY TYPE 32ft. MASTS similar to above but 10 lin. screw-sections, suitable for permanent lightweight installation. Kit in canvas bag, £5/10/-. Carriage 12/6.

TELEPRINTER EQUIPMENT

CREED (BRITISH)

&

TELETYPE (U.S.A.)

MICRO SWITCHES

BURGESS

BRAND NEW MINISTRY RELEASE

MK. 4 BR METAL BODY UNIVERSAL CONTACT A.M. Ref. 5C/4008

78/- PER DOZ. (min. quantity) **£25** PER 100

Compare this remarkable almost half-price offer with manufacturer's prices.

RELAYS MINIATURE SEALED SIEMENS' TYPE

High Speed Single change-over

H96A, 5.7Ω + 2.5Ω	15/6
H96B, 50Ω + 80Ω	17/6
H96C, 145Ω + 145Ω	19/6
H96D, 500Ω + 500Ω	22/6
H96E, 1,700Ω + 1,700Ω	25/-

SPECIAL QUOTATIONS ON QUANTITY & EXPORT ENQUIRIES

HATTER & DAVIS (RELAYS) LTD.

2, IRONGATE WHARF ROAD, PRAED ST., LONDON, W.2

PAD 2231/2/3

75% OFF

S.T.C. RECTIFIER SUPPLY UNIT

Specification: A.C. input 100/260 volts 45/65 cycles D.C. output **24 volts** at 10 amps. under tropical conditions (i.e. 131° F.) but ***guaranteed*** of full meter current of 20 amps.

No: 1 ZB 10234

HEAVY DUTY

CHARGER

All circuits fused and switched for full 20 amps. or 24 volts at 125/350/700 milliamps. (Circuit diagrams and instruction book supplied). Constructed in grey metal cabinet as illustrated the unit is 2ft. 8in. high x 2ft. long x 1ft. 3½in. deep, and weighs 141 lbs.

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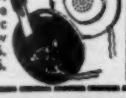

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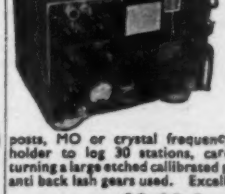

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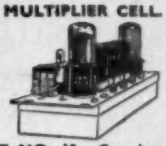

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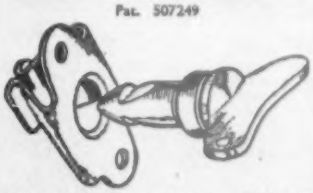

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ECL80	13/6	U10	10/6	6AC7	6/6
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EF39	6/6	U37	27/10	6AM6	8/6
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EL32	5/6	UCC84	20/11	6BR7	11/6
EL33	16/-	UCF80	23/-	6BW6	8/6
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EF55	10/-			6SG7	7/6
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				6SQ7	9/3
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				12K7GT	7/6
				12K8GT	13/6
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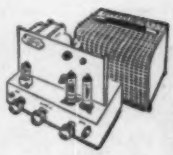

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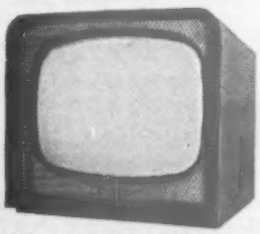

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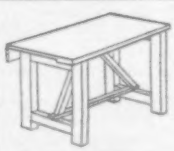

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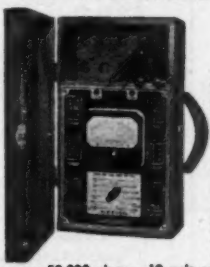

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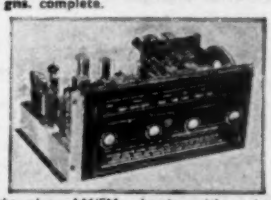

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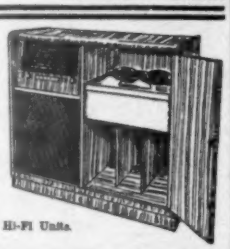

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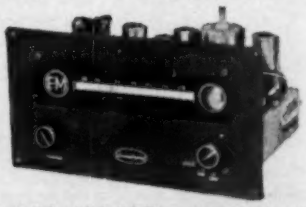

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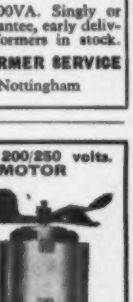

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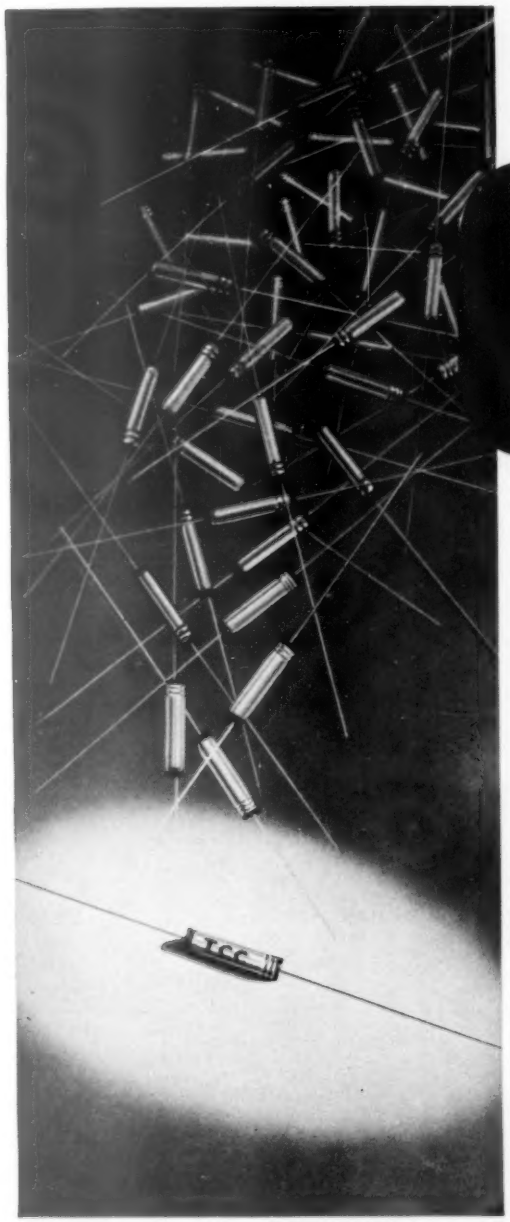


TCC

We have now been producing these Sub-miniature Electrolytic condensers for a considerable time, and the range has been increased to keep pace with the demand for miniaturised components. These condensers—shown here actual size—fit into the smallest assemblies; no longer is it necessary for designers to be governed by the size of the condensers.

As this range was originally developed for use with transistors, they have been the subject of considerable interest to manufacturers of hearing aids and similar assemblies where every component is scaled down to minimum size.

The condenser element is hermetically sealed in an aluminium tube with rubber bungs (T.C.C. Patents 578487, 587072 and 578409) and an attractive feature of our design is that the wire terminations may be flexed right up to the body of the condenser.

These condensers are available when required with a thin P.V.C. insulating sleeve.

Capacity in μF	Peak Wkg. Volts	Dimensions in ins.		T.C.C. Type No.	List Price
		Length	Diam.		
2	8	⅜″	⅛″	CE58A	5/-
4	4	⅜″	⅛″	CE58AA	5/-
1	12	⅜″	⅛″	CE58B	5/-
6	1·5	⅜″	⅛″	CE58	5/-
0·25	25	⅜″	⅛″	CE58C	5/-
10	3	⅜″	·18	CE68AA	4/-
8	6	⅜″	·18	CE68AE	4/-
4	12	⅜″	·18	CE68BE	4/-
2	25	⅜″	·18	CE68CE	4/-
0·1	50	⅜″	·18	CE68D	4/-
0·5	50	⅜″	·18	CE68D	4/-
1	50	⅜″	·18	CE68DE	4/-
20	6	½″	·2	CE69AE	4/-
10	12	½″	·2	CE69BE	4/-
4	25	½″	·2	CE69CE	4/-
2	50	½″	·2	CE69DE	4/-
50	6	½″	¼″	CE67AE	4/-
25	12	½″	¼″	CE67BE	4/-
12	25	½″	¼″	CE67CE	4/-

TCC

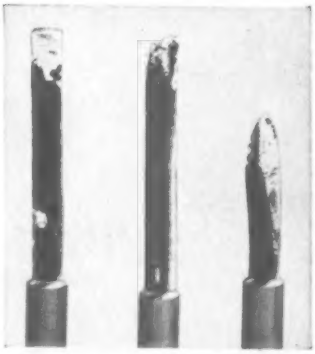
CONDENSER SPECIALISTS SINCE 1906

UP TO 10 TIMES LONGER BIT LIFE

WITH [redacted] TYPE 1 ALLOY

Ersin Multicore Savbit Type 1 Alloy incorporates a small percentage of copper, thus preventing absorption of copper from the bit itself and extending the life of copper bits up to 10 times.

Savbit does not reduce soldering speed; in fact, by keeping the bits in good condition it actually increases soldering efficiency. It has been tested and proved on many famous production lines. Write for further information to the Multicore Service Department.



The left hand bit was used with Savbit alloy and has made 10,000 joints. The centre bit was used for 1,000 joints and the bit on the right for 7,500 joints, each with a standard tin/lead alloy.

SAVBIT FOR FACTORIES

Ersin Multicore Savbit Type 1 alloy containing 5 Cores of non-corrosive flux is supplied to factories at bulk prices on 7 lb. reels. 16 and 18 s.w.g. are the diameters most suitable for the majority of soldering processes. Supplies are also available on 1 lb. reels.

SAVBIT FOR THE SMALL USER

The Size 1 Carton contains approximately 53 ft. of 18 s.w.g. SAVBIT. It is also supplied in 14 s.w.g. and 16 s.w.g. Obtainable from radio and electrical stores. Ersin Multicore 5-Core Solder is also supplied in 4 specifications of Standard Tin/Lead alloys.
Price 5/- each (subject).

SAVBIT FOR THE SERVICE ENGINEER

Approx. 170 ft. of 18 s.w.g. SAVBIT is supplied on a 1 lb. reel packed in a carton. Price 15/- each (subject).

SPECIAL HIGH AND LOW MELTING POINT SOLDERS

Comsol (Melting point 296°C)
P.T. (Melting point 232°C)
L.M.P. (Melting point 179°)C
T.L.C. (Melting point 145°C)

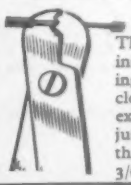
STANDARD TIN/LEAD ALLOYS

Ersin Multicore 5-core Solder is available in the following standard alloys:
60/40, 50/50, 45/55, 40/60, 30/70, and 20/80 and in 9 gauges on 7 lb. and 1 lb. reels.

HOME CONSTRUCTOR'S 2/3 PACK

Now available containing alternative specifications: 19 ft. of 18 s.w.g. 60/40 alloy or, for soldering printed circuits, 40 ft. of 22 s.w.g. 60/40 alloy. Both wound on Reels. 2/6 each (subject).

Bib WIRE STRIPPER AND CUTTER



This 3 in 1 tool strips insulation without nicking the wire, cuts wire cleanly and splits plastic extruded twin flex. Adjustable to most wire thicknesses.
3/6 each (subject).

Bib RECORDING TAPE SPLICER

Recording enthusiasts can effect considerable tape economies with this splicer. It makes the accurate jointing of tape so simple and quick that every scrap can be used.
18/6 each (subject).

A free copy of an interesting article "How to Edit Tape Recordings" will be sent you if you will kindly send us a stamped addressed envelope.

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